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# The importance of different biophysical variables in the assessment of fetal weight, fetal mortality, perinatal distress, apgar score and fetal well-being: a biophysical profile model

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ABSTRACT: *The authors examine 13 biophysical variables and compare them with five different perinatal outcomes (weight, distress, apgar score at 5', overall outcome, perinatal mortality). 212 patients were examined within 3 weeks from delivery. The variables were quantified by different numeric values: 3 for normal, 2 for borderline, 1 for pathologic.*
*Statistical analysis showed different correlations for each variable depending on the considered gold standard.*
*The biometric values showed the best correlation with weight. Amniotic fluid volume, cordal risk and fetal blood flow velocity waveforms correlated with distress. Fetal tone and biometry correlated well with apgar score at 5'. Fetal blood flow velocity waveform, fetal tone, fetal body movements, Non Stress Test, correlated with mortality. Overall outcome correlated well with biometry, fetal tone and fetal Doppler velocimetry. Uterine morphology resulted an independent variable when compared to the considered perinatal outcome.*

KEY WORDS: Biophysical profile, Biophysical variables, Fetal well-being.

## INTRODUCTION

At present, the fetal biophysical profile score is one of the most reliable methods for assessment of fetal well-being compared to other tests performed during the antenatal period.
This test, proposed by Manning (1), includes an ultrasound scan to record fetal dynamic variables (gross body movements and fetal tone, diaphragm breathing movements, NST) and a quantitative assessment of amniotic fluid volume.
The first four variables indicate the integrity of a CNS, while a decrease in amniotic fluid is considered by some authors (2) one of the most important markers of fetal stress with high negative pragnostic value.
In a retrospective study, Manning (3) observed that the predictivity of the four ultrasonographic variables is identical, except for the Non Stress Test; the author therefore suggests

(4) using the Non Stress Test only when one or more ultrasonographic variables prove pathologic.
The fetal biophysical profile represents the quantification in a score assigned to single variables with prognostic values between 3 and 1 for fetal well-being. There are however some drawbacks to this methodology, for example the total score may in some cases prove significant, while in others it is advisable to examine variable scores individually since each of these indicates a particular risk condition.
The following is an outline of the relative importance of the various biophysical parameters at the present moment.
Studies performed by other authors, albeit based on numerous clinical records, refer to a limited number of biophysical variables; no account is taken for example of fetal-maternal flow matering data and funicular growth, which are both clinical indexes of fundamental importance.
The aim of this work was to determine which biophysical variable or which association of variables and with what degree of statistic significance a given gold standard can be predicted.
Numerous previous surveys have lacked a suitable articulation of the gold standard by not taking into account the fact that these variables may alter the overall outcome.
This work consequently suggests a new pattern of biophysical profile by including a great number of variables and correlating them individually to various perinatal events to establish the relative importance of variables with regard to the different overall outcome.
Not all variables were however considered in each case.
The measured parameters were as follows.
- Fetal distress during labor
- Low 5' Apgar score
- Small for gestational age
- Perinatal mortality
- Overall outcome.

Value 1 represents the absence and value 0 the presence of complications identified at birth.
The final rating called "overall outcome" was a score ranging between 0 -worst outcome- and 4 -best outcome. Each biophysical variable was compared with the four different gold standards and the overall outcome. A stochastic and statistic analysis of the connective tissue was performed using the unilateral dependency indexes of x and y.
These methods were used to analyze the specificity, sensitivity, positive and negative predictivite value and accuracy.

## MATERIALS AND METHODS

A total of 212 patients entered the study, and a selected sample was taken from 179 different observations performed over a period from 0 to 21 days before delivery.
The results of the biophysical profile were not taken into consideration for clinical management and patients were monitored using the traditional biochemical and biophysical methodologies.
The biophysical profile we illustrate consists of 13 variables.
The significance of biophysical variables was separated for each single variable and the values: 3 = normal, 2 = borderline, 1 = pathologic, were attributed (Table I).

TABLE I

| | | | |
|---|---|---|---|
| CEHPALOMETRICS (bpd) | −1 +2 SD | −1 -2 SD | −2 +2 SD |
| ABDOMINOMETRICS (atd) | −1 +2 SD | −1 -2 SD | −2 +2 SD |
| FEMUR | −1 +2 SD | −1 -2 SD | −2 +2 SD |
| BODY MOVEMENTS | >3 MOV. 30' STATE 2 | 1-3 MOV. 30' STATE 2 | ABSENCE OF MOVEMENTS |
| TONE | ROUNDISH ABDOMEN AND CHEST | ELLIPSOID ABDOMEN AND CHEST | ABDOMEN AND CHEST NO FLEXION-EXTENSION MOV. |
| BREATHING MOVEMENTS | AT LEAST ONE PERIOD OF RESPIRATORY ACTIVITY | SPORADIC RESPIRATORY ACTIVITY | ABSENCE OF OR PATHOLOGIC RESPIRATORY ACTIVITY |
| CTG | >3 ACCEL. (15X15) | 1-3 ACCEL. (15X15) | NO ACCEL. AND/OR DECEL. |
| FETAL FLOW-METERING | NORMAL AND PERIPHERAL NORMAL FLOWS | PERIPHERAL FLOWS: Limit + CENTRAL FLOWS: Limit − | CENTRALIZATION AND/OR EDF |
| MATERNAL FLOW-METERING | ARCUATE AND/OR UTERINE NORMAL R.I. | ARCUATE AND/OR UTERINE 2 SD LIMIT VALUES | OVER 2 SD VALUES OR DIFFERENCE DX-SX> 0.2 R.I. |
| AMNIOTIC FLUID | 3 RIDGES >2 cm. 1 RIDGE > 4 cm. | 1-3 RIDGES >2 cm. (FUNICULAR DIAM. >1.4 cm.) | 1-3 RIDGES >2 cm. (Fun. Diam. <1.4 cm) < 1 RIDGE > 2 cm. |
| CORDAL RISK | NORMAL GROWTH AND LENGHT | OBLIQUE UNCROSSED LOOP | - CORD LOOPS -KNOT - TOO SHORT |
| PLACENTAL STRUC. AND MORPH. | NORMAL MORPH. AND INSERTION | HYPERMATURE FOR GESTATIONAL STAGE | HYPERMATURE + REDUCED VOL. INSERTION ALTERATION |
| UTERINE MORPHOLOGY | NORMAL MORPH. AND STRUCTURE | FIBROTIC AREAS OPERATIONS | MALFORMATION + FIBROMA |
| | | | SCORE |

The variables considered were:
1) *Biparietal diameter* (BPD)
2) *Transverse abdominal diameter (TAD) and circumference*
3) *Femur length*
Values ranging between +2SD and −1SD were considered normal, borderline when between −2SD and −1SD, and pathologic when between −2SD and +2SD.
4) *Body movements:* the presence of more than three body movements in 30 minutes in phase B (6, 7) was considered normal, 1 to 3 movements in 30 minutes in phase B were considered borderline, and the absence of movements pathologic.
5) *The Fetal tone variability* was also considered by assessment of the roundness of the chest and abdomen: a rounded chest and abdomen were considered corresponding to a normal tone, whereas if roughly ellipsoid with absence of flexion-extension movements of the limbs they were regarded as pathologic (Figure 1).
6) *Respiratory movements:* normal when at least one respiratory movement was present in 30", borderline when respiratory activity was sporadic, and pathologic when respiratory activity was absent or anomalous.
7) *Cardiotocographic pattern:* it was considered normal when there were more than three accelerations in 20 minutes activity, borderline when there were 1 to 3 accelerations, pathologic if there were no accelerations and/or decelerations.
8) *Fetal Doppler velocimetry:* it was considered normal when the umbilical arterial (UA) and internal carotid artery (CA) ratio was within the normal range, borderline when the

UA/CA ratio was between −1 and −1SD (Figure 2), pathologic when it was below −2SD and/or aortic end diastolic fraction (EDF) was negative.


**Fig. 1 - Fetal tone variability.**
**a) Round abdomen.**
**b) Ellipsoid abdomen.**
**c) Roughly ellipsoid abdomen.**

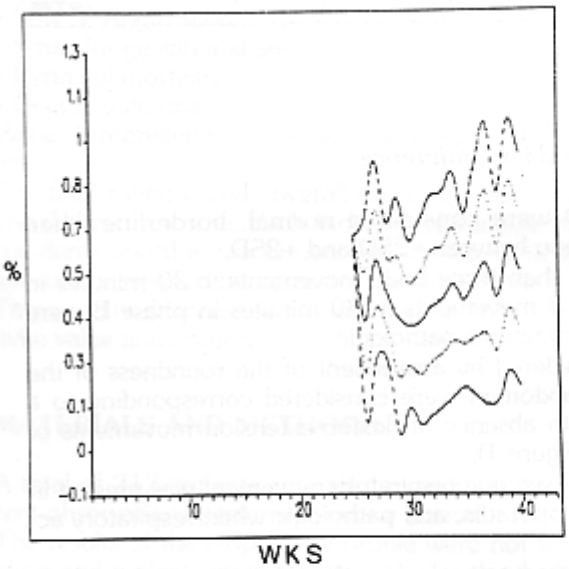
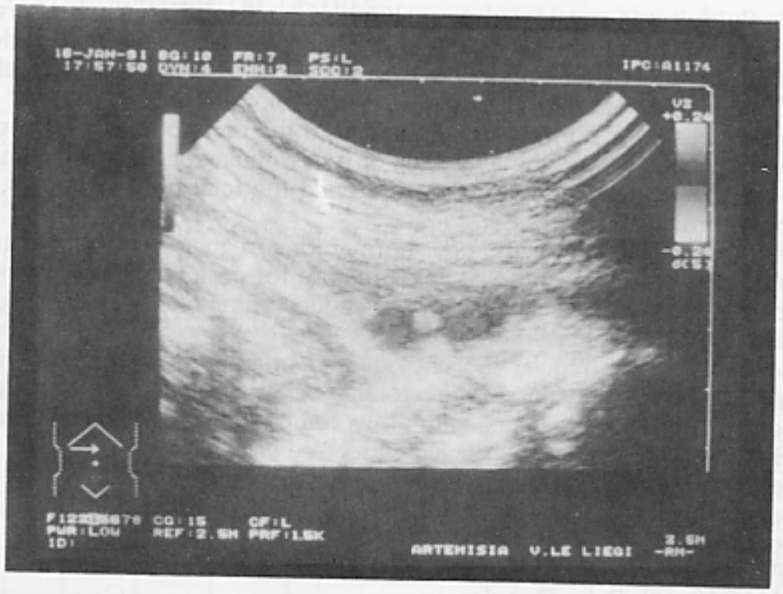



**Fig. 2 - UA/CA ratio.**

9) *Maternal Doppler velocimetry:* it was considered normal when the resistance of the uterine or arcuate uterine arteries was within the normal range, borderline when both arteries were between +1SD and +2SD, pathologic when one or both arteries were below 2SD.



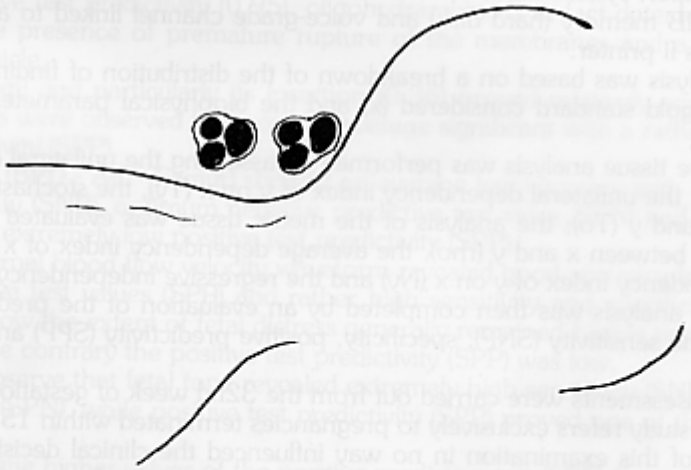



Fig. 3 - Longitudinal scan of two cord loops around the fetal neck.

TABLE II - GOLD STANDARD = FETAL-DISTRESS

| | | CONNECTIVE TISSUE | | | ACCURACY | | | | PREDICTIVITY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N. | Tx | Ty | To | RHo | Nx | Ny | Nm | SNP | SNN | SPP | SPN |
| **B.P.D.** | 165 | 0,08 | 0,04 | 0,06 | 0,22 | 0,29 | 0,22 | 0,25 | 0,91 | 0,66 | 0,16 | 0,80 |
| **A.C.** | 164 | 0,08 | 0,04 | 0,06 | 0,29 | 0,29 | 0,29 | 0,29 | 0,79 | 0,69 | 0,18 | 0,86 |
| **FEMUR** | 164 | 0,08 | 0,04 | 0,06 | 0,27 | 0,28 | 0,27 | 0,27 | 0,89 | 0,67 | 0,13 | 0,87 |
| **B.M.** | 177 | 0,07 | 0,03 | 0,05 | 0,25 | 0,26 | 0,25 | 0,26 | 0,75 | 0,67 | 0,05 | 0,95 |
| **TONE** | 179 | 0,11 | 0,05 | 0,07 | 0,32 | 0,33 | 0,32 | 0,32 | 1,00 | 0,67 | 0,03 | 0,98 |
| **Br. M.** | 175 | 0,06 | 0,03 | 0,04 | 0,24 | 0,25 | 0,24 | 0,25 | 0,53 | 0,73 | 0,41 | 0,72 |
| **C.T.G.** | 172 | 0,06 | 0,03 | 0,04 | 0,25 | 0,25 | 0,25 | 0,25 | 0,69 | 0,68 | 0,17 | 0,86 |
| **F. FLOW** | 176 | 0,09 | 0,05 | 0,06 | 0,28 | 0,30 | 0,28 | 0,29 | 0,82 | 0,68 | 0,21 | 0,86 |
| **M. FLOW** | 164 | 0,08 | 0,04 | 0,06 | 0,28 | 0,29 | 0,28 | 0,28 | 0,63 | 0,72 | 0,18 | 0,80 |
| **A.F.** | 178 | 0,12 | 0,06 | 0,08 | 0,35 | 0,35 | 0,35 | 0,35 | 1,00 | 0,71 | 0,10 | 0,95 |
| **CORD RISK** | 174 | 0,06 | 0,03 | 0,04 | 0,23 | 0,25 | 0,23 | 0,24 | 0,72 | 0,69 | 0,19 | 0,64 |
| **PLACENTA** | 162 | 0,14 | 0,07 | 0,10 | 0,35 | 0,38 | 0,35 | 0,36 | 0,58 | 0,78 | 0,12 | 0,74 |
| **UTERUS** | 70 | 0,01 | 0,01 | 0,01 | 0,08 | 0,11 | 0,08 | 0,10 | 0,50 | 0,58 | 0,03 | 0,95 |

As regards the fetal *distress at birth* (Table II), we demonstrated that a precise distress index at birth was the quantity of amniotic fluid (0,35) with a 1.00 sensitivity (SNP) and an extremely high negative test predictivity (0.95). oligohydramnios is in fact detected in chronic fetal distress, in the presence of premature rupture of the membranes and a pronounced shortness of the funicle.

Placental morphology and particularly its insertion (0.36) proved relatively accurate, while all predictivity values were observed to be on the average significant with a rather low (0.12) positive test predictivity (SPP).

All biometric values (BPD - AC - Femur) showed an average low accuracy with on the other hand, good sensitivity (SNP), optimum negative predictive test value (SPN) and lower specificity (SNN) with an extremely low positive test predictivity (SPP).

Both fetal and maternal blood flow velocity waveform revealed good accuracy levels with high positive predictive test values (SPP) and rather high sensitivity and specificity. It should be noted however how the extent of fetal distress generally remained higher than the maternal one, while on the contrary the positive test predictivity (SPP) was low.

It is interesting to observe that fetal tone revealed extremely high sensitivity (SNP) and negative test predictivity (SPN), while positive test predictivity (SPP) proved one of the lowest recorded.

On the other hand, the higher values of the positive predictive test (SPP) for respiratory movements appear strange. This finding could open new horizons in the study of the continuity of respiratory dynamics in the fetal period.

Another important finding was the average of positive test predictivity (SPP) in connection with cord risk. The evaluation of cords risks has great limitations due to the high number of false negatives detected by ultrasonography.

The statistical analysis correlating variables to *5' Apgar* (Table III) at birth revealed a good degree of accuracy both as regards fetal tone and biometric values.

10) *Amniotic fluid:* it was considered normal the presence of three pockets greater than 2 cm. or one pocket greater than or equal to 4 cm., borderline one to three pockets 2-3 cm. associated with a cord diameter over 1,4 cm. pathologic if there was one pocket equal to or lesser than 2 cm. with a cord diameter below 1,4 cm. (8).
11) *Cordal risk:* absent for normal size and lenght of the cord, borderline if there was only one cord loop extending behind the fetal neck or redescending at the front of the trunk obliquely, pathologic for one or more cord loops around the fetal neck (Figure 3), or the presence of a short cord or a knot.
12) *Placental structure and morphology:* normal for a regular morphology and placental insertion, borderline if the placenta was hypermature for gestational age, pathologic if the placenta hypermature was associated with the reduced amniotic fluid quantity or if there was an alteration in placental insertion.
13) *Uterine morphology:* a regular morphology and structure was considered normal, borderline if there had been previous hysterectomies or areas of fibrosis, pathologic if there was a uterine malformation associated with a myoma node with a diameter of more than 5 cm.; this variable was taken from statistical control (see below).
The equipment used was the following:
— *Cardiotocographs:* Hewlett Packard 840/A
— *Ultrasonographic apparatus:*
Ansaldo AU 450 with Pulse Doppler
Ansaldo AU 940 with Pulse Doppler
Ansaldo AU 920 for the survey of fetal behaviour during cardiotocographic examination
Convex probes ranging from 3 to 5 Mhz frequencies were used.
We used an expert system made up of 3 AT 286 computers with 12 Mhz processing speed (clock), 100 MB memory (hard disk) and voice-grade channel linked to a Hewlett Packard Laserjet, series II printer.
Statistical analysis was based on a breakdown of the distribution of findings, making tables adopting the gold standard considered (x) and the biophysical parameter (y) (Tables II, III, IV, V, and VI).
The connective tissue analysis was performed by assessing the unilateral dependency index of x on y (Tx), the unilateral dependency index of y on x (Ty), the stochastic dependency index between and y (To); the analysis of the metric tissue was evaluated by the linear correlation index between x and y (rho), the average dependency index of x on y (Nx) and the average dependency index of y on x (Ny) and the regressive independency index (Nm).
The statistical analysis was then completed by an evaluation of the predictivity indexes by determining the sensitivity (SNP), specificity, positive predictivity (SPP) and negative predictivity (SPN).
Biophysical assessments were carried out from the 32nd week of gestation on. The data reported in this study refers exclusively to pregnancies terminated within 15 days of sampling.
The findings of this examination in no way influenced the clinical decisions on obstetrical management which, furthermore, followed the traditional scheme of biochemical and biophysical examinations.

## RESULTS

The data obtained from our statistical analysis confirme the hypothesis that each biophysical parameter reveals different validity according to the considered gold standard (Tables II, III, IV, V and VI).

TABLE III - GOLD STANDARD = APGAR 5'

| | | CONNECTIVE TISSUE | | | ACCURACY | | | | PREDICTIVITY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N. | Tx | Ty | To | RHo | Nx | Ny | Nm | SNP | SNN | SPP | SPN |
| **B.P.D.** | 165 | 0,15 | 0,07 | 0,10 | 0,34 | 0,38 | 0,34 | 0,35 | 0,45 | 0,96 | 0,38 | 0,79 |
| **A.C.** | 164 | 0,11 | 0,06 | 0,08 | 0,33 | 0,34 | 0,33 | 0,33 | 0,36 | 0,96 | 0,38 | 0,81 |
| **FEMUR** | 164 | 0,19 | 0,10 | 0,14 | 0,44 | 0,44 | 0,44 | 0,44 | 0,44 | 0,98 | 0,31 | 0,85 |
| **B.M.** | 177 | 0,03 | 0,02 | 0,02 | 0,18 | 0,18 | 0,18 | 0,18 | 0,25 | 0,94 | 0,08 | 0,91 |
| **TONE** | 179 | 0,14 | 0,07 | 010 | 0,36 | 0,37 | 0,36 | 0,37 | 0,50 | 0,96 | 0,08 | 0,94 |
| **Br. M.** | 175 | 0,04 | 0,02 | 0,03 | 0,16 | 0,20 | 0,16 | 0,16 | 0,12 | 0,96 | 0,46 | 0,65 |
| **C.T.G.** | 172 | 0,01 | 0,00 | 0,00 | 0,06 | 0,08 | 0,06 | 0,06 | 0,13 | 0,94 | 0,18 | 0,79 |
| **F. FLOW** | 176 | 0,08 | 0,04 | 0,06 | 0,29 | 0,29 | 0,29 | 0,29 | 0,29 | 0,96 | 0,36 | 0,82 |
| **M. FLOW** | 164 | 0,10 | 0,05 | 0,07 | 0,29 | 0,31 | 0,29 | 0,30 | 0,50 | 0,94 | 0,23 | 0,89 |
| **A.F.** | 178 | 0,05 | 0,02 | 0,03 | 0,20 | 0,22 | 0,20 | 0,20 | 0,16 | 0,96 | 0,21 | 0,73 |
| **CORD RISK** | 174 | 0,01 | 0,01 | 0,01 | 0,11 | 0,12 | 0,11 | 0,11 | 0,17 | 0,94 | 0,21 | 0,58 |
| **PLACENTA** | 162 | 0,05 | 0,02 | 0,03 | 0,21 | 0,21 | 0,21 | 0,21 | 0,25 | 0,96 | 0,23 | 0,62 |
| **UTERUS** | 70 | 0,01 | 0,00 | 0,00 | -0,07 | 0,08 | 0,07 | 0,07 | 0,00 | 0,92 | 0,00 | 0,92 |

TABLE IV - GOLD STANDARD = FETAL WEIGHT

| | | CONNECTIVE TISSUE | | | ACCURACY | | | | PREDICTIVITY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N. | Tx | Ty | To | RHo | Nx | Ny | Nm | SNP | SNN | SPP | SPN |
| **B.P.D.** | 165 | 0,46 | 0,23 | 0,33 | 0,67 | 0,68 | 0,67 | 0,67 | 1,00 | 0,95 | 0,39 | 0,87 |
| **A.C.** | 164 | 0,46 | 0,23 | 0,32 | 0,67 | 0,68 | 0,67 | 0,67 | 0,93 | 0,95 | 0,47 | 0,89 |
| **FEMUR** | 164 | 0,36 | 0,18 | 0,25 | 0,59 | 0,60 | 0,59 | 0,59 | 1,00 | 0,92 | 0,32 | 0,89 |
| **B.M.** | 177 | 0,22 | 0,11 | 0,15 | 0,45 | 0,47 | 0,45 | 0,46 | 0,75 | 0,91 | 0,11 | 0,95 |
| **TONE** | 179 | 0,27 | 0,13 | 0,19 | 0,51 | 0,52 | 0,51 | 0,51 | 1,00 | 0,90 | 0,07 | 0,97 |
| **Br. M.** | 175 | 0,04 | 0,02 | 0,03 | 0,19 | 0,20 | 0,19 | 0,19 | 0,24 | 0,90 | 0,44 | 0,67 |
| **C.T.G.** | 172 | 0,13 | 0,06 | 0,09 | 0,36 | 0,36 | 0,36 | 0,36 | 0,50 | 0,91 | 0,31 | 0,84 |
| **F. FLOW** | 176 | 0,38 | 0,19 | 0,21 | 0,60 | 0,61 | 0,60 | 0,61 | 0,82 | 0,94 | 0,48 | 0,88 |
| **M. FLOW** | 164 | 0,13 | 0,06 | 0,09 | 0,33 | 0,36 | 0,33 | 0,34 | 0,83 | 0,87 | 0,18 | 0,91 |
| **A.F.** | 178 | 0,12 | 0,06 | 0,08 | 0,34 | 0,34 | 0,34 | 0,34 | 0,47 | 0,91 | 0,31 | 0,77 |
| **CORD RISK** | 174 | 0,03 | 0,02 | 0,02 | 0,17 | 0,18 | 0,17 | 0,17 | 0,33 | 0,88 | 0,21 | 0,60 |
| **PLACENTA** | 162 | 0,11 | 0,05 | 0,08 | 0,32 | 0,33 | 0,32 | 0,33 | 0,42 | 0,93 | 0,18 | 0,66 |
| **UTERUS** | 70 | 0,02 | 0,01 | 0,01 | -0,12 | 0,13 | 0,12 | 0,12 | 0,00 | 0,82 | 0,00 | 0,91 |

These data moreover show optimum specificity (SNN) and high negative test predictivity values (SPN). This finding can be clearly justified taking into consideration that the physical structure and fetal tone are extremely important in the postnatal adaptation period.
All biophysical tests generally showed good Apgar at 5' specificity (SNN).

Fetal blood flow velocity revealed good positive test values (SPP) and optimum negative test predictivity values (SPN).

The statistical analysis of the biophysical variables correlated with *weight* (Table IV) clearly confirms the dominant role of biometry by revealing greater accuracy and predictivity for abdominometrics, femurometrics, and cephalometrics.

The remaining data assessed present some problems as regards *interpretation and furthermore the Rho* value (as a marker of the variable considered) generally proves rather low, with the exception of fetal blood flow velocity which is known to be altered particularly in case of growth retardation.

The statistical analysis of biophysical variables correlated with perinatal mortality (Table V) demonstrated the highest linear (Rho) correlation (dependency) for fetal biometry, tone, body movements, cardiotocographic pattern and fetal blood flow velocity.

The highest positive test predicitivity levels (SPP) were observed for the fetal biometry, respiratory movements (i.e. Cheyns Stokes-gasping), cardiotocography and fetal blood flow velocity.

Finally, it was observed that the greatest dependency amongst the correlated variables and the series of gold standards (Table VI) were yielded by the whole biometric values. Fetal blood flow velocity also revealed high negative test predictivity (SPN), which was also confirmed by a high linear correlation index (Rho).

The study of respiratory movements, although apparently discreetly predictive, is probably less important than it appears if we consider the low Rho value a linear correlation between gold standard and the individual variable. Our protocol furthermore included a biophysical variable, uterine morphology, which was obviously less important as regards the gold standards sought. This was done for the purpose of obtaining reference data. The statistical analysis moreover revealed that the study of uterine morphology presented the lowest linear correlations (Rho), and sometimes even an absolute independence of the biophysical variable (uterus) from the gold standard considered (Rho=0.00).

TABLE V - GOLD STANDARD = MORTALITY

| | | CONNECTIVE TISSUE | | | ACCURACY | | | | PREDICTIVITY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N. | Tx | Ty | To | RHo | Nx | Ny | Nm | SNP | SNN | SPP | SPN |
| **B.P.D.** | 165 | 0,17 | 0,09 | 0,12 | 0,32 | 0,41 | 0,32 | 0,32 | 0,18 | 1,00 | 1,00 | 0,77 |
| **A.C.** | 164 | 0,13 | 0,07 | 0,09 | 0,30 | 0,36 | 0,30 | 0,31 | 0,14 | 1,00 | 1,00 | 0,79 |
| **FEMUR** | 164 | 0,21 | 0,11 | 0,15 | 0,35 | 0,46 | 0,35 | 0,36 | 0,22 | 1,00 | 1,00 | 0,81 |
| **B.M.** | 177 | 0,12 | 0,06 | 0,08 | 0,23 | 0,34 | 0,23 | 0,24 | 0,25 | 0,99 | 0,50 | 0,90 |
| **TONE** | 179 | 0,24 | 0,12 | 0,17 | 0,28 | 0,49 | 0,28 | 0,31 | 0,50 | 0,99 | 0,50 | 0,92 |
| **Br. M.** | 175 | 0,03 | 0,01 | 0,02 | 0,16 | 0,17 | 0,16 | 0,16 | 0,04 | 1,00 | 1,00 | 0,64 |
| **C.T.G.** | 172 | 0,06 | 0,03 | 0,04 | 0,20 | 0,24 | 0,20 | 0,21 | 0,06 | 1,00 | 1,00 | 0,79 |
| **F. FLOW** | 176 | 0,11 | 0,05 | 0,08 | 0,28 | 0,33 | 0,28 | 0,29 | 0,12 | 1,00 | 1,00 | 0,80 |
| **M. FLOW** | 164 | 0,08 | 0,04 | 0,05 | 0,20 | 0,27 | 0,20 | 0,21 | 0,17 | 0,99 | 0,50 | 0,88 |
| **A.F.** | 178 | 0,03 | 0,02 | 0,02 | 0,17 | 0,17 | 0,17 | 0,17 | 0,05 | 1,00 | 0,50 | 0,71 |
| **CORD RISK** | 174 | 0,00 | 0,00 | 0,00 | -0,01 | 0,05 | 0,01 | 0,01 | 0,00 | 0,99 | 0,00 | 0,57 |
| **PLACENTA** | 162 | 0,08 | 0,04 | 0,05 | 0,19 | 0,28 | 0,10 | 0,19 | 0,08 | 1,00 | 1,00 | 0,60 |
| **UTERUS** | 70 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 1,00 | 0,00 | 0,93 |

TABLE VI - GOLD STANDARD = OVER ALL OUTCOME

| | | CONNECTIVE TISSUE | | | ACCURACY | | | | PREDICTIVITY | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N. | Tx | Ty | To | RHo | Nx | Ny | Nm | SNP | SNN | SPP | SPN |
| **B.P.D.** | 165 | 0,12 | 0,24 | 0,17 | 0,54 | 0,59 | 0,60 | 0,59 | 0,45 | 0,93 | 0,71 | 0,84 |
| **A.C.** | 164 | 0,11 | 0,22 | 0,15 | 0,57 | 0,58 | 0,62 | 0,59 | 0,36 | 0,94 | 0,71 | 0,88 |
| **FEMUR** | 164 | 0,12 | 0,23 | 0,16 | 0,57 | 0,58 | 0,61 | 0,59 | 0,44 | 0,92 | 0,57 | 0,88 |
| **B.M.** | 177 | 0,08 | 0,16 | 0,11 | 0,41 | 0,41 | 0,43 | 0,42 | 0,25 | 0,91 | 0,14 | 0,95 |
| **TONE** | 179 | 0,16 | 0,32 | 0,23 | 0,53 | 0,53 | 0,64 | 0,55 | 0,50 | 0,92 | 0,14 | 0,99 |
| **Br. M.** | 175 | 0,03 | 0,05 | 0,04 | 0,28 | 0,29 | 0,29 | 0,29 | 0,10 | 0,92 | 0,71 | 0,68 |
| **C.T.G.** | 172 | 0,05 | 0,10 | 0,07 | 0,33 | 0,33 | 0,40 | 0,36 | 0,13 | 0,91 | 0,33 | 0,84 |
| **F. FLOW** | 176 | 0,10 | 0,20 | 0,14 | 0,52 | 0,54 | 0,60 | 0,56 | 0,24 | 0,94 | 0,50 | 0,88 |
| **M. FLOW** | 164 | 0,08 | 0,15 | 0,11 | 0,43 | 0,44 | 0,45 | 0,45 | 0,50 | 0,90 | 0,38 | 0,93 |
| **A.F.** | 178 | 0,06 | 0,12 | 0,08 | 0,37 | 0,38 | 0,41 | 0,39 | 0,05 | 0,92 | 0,12 | 0,77 |
| **CORD RISK** | 174 | 0,03 | 0,06 | 0,04 | 0,23 | 0,24 | 0,30 | 0,26 | 0,11 | 0,87 | 0,25 | 0,59 |
| **PLACENTA** | 162 | 0,07 | 0,14 | 0,10 | 0,41 | 0,42 | 0,44 | 0,43 | 0,08 | 0,92 | 0,14 | 0,65 |
| **UTERUS** | 70 | 0,01 | 0,02 | 0,01 | -0,03 | 0,04 | 0,15 | 0,07 | 0,00 | 0,83 | 0,00 | 0,92 |

## COMMENT

Monitoring of fetal well-being still a matter of discussion but the reliability of the different methods of evaluation is far from being clear-cut.

We have the impression that the reason of this debate is in the fact that each method is deviced to study only a well defined perinatal outcome. The aim of our study was to assess the effectiveness of each biophysical variable in predicting perinatal outcome, becouse it is obvious that 13 parameters of biophysical profile for clinical routine are extremely difficult to obtain.

Thus we think that only biophysical profile dealing with comparable perinatal outcomes can be a matter of discussion with regard to the outcome of pregnancy.

An interesting observation is how the most traditional biophysical evaluations (biometry, tone, CTG, body movements, respiratory movements, amniotic fluid, etc.) proved to be obviously important compared to more modern surveys (fetal blood flow velocity) as regards the predictivity of gold standards considered.

It should be borne in mind however that one last gold standard, the handicap, was not considered.

The distribution of fetal blood flow with the well known concept of "brain sparing" (9, 10) effect with cerebral vasodilation probably shows high correlation with any latent neurological damage, particularly when the persistent hypoxia determine the loss of central autoregulation flow control (11) that is in relation to intrinsic capacities of technique used to detect even minimal change in oxygenation.

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