

# Flowmetric Biological Scale in Advanced Pregnancy

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## **Abstract**

Fetal and umbilical vessels' Doppler measurements in the course of pregnancy were performed in many previous studies. Those cross-sectional studies revealed progressive gestational decrease in vascular resistance and permitted to establish the mean and range Doppler values in consecuted weeks of gestation, and find out the correlation between flowmetric values and gestational age. Unfortunately that correlation disappeared after 37th week of gestation. The authors of previous reports have overcome it by limitation of the examination to 40th or 42th week of pregnancy or by use of logarithmic scale in estimation of regression line. Even with statistical manipulation that advanced pregnancy studies could not be regarded as true cross-sectional one.

In this study we performed Doppler wave measurements in umbilical artery in group of 70 advanced, retrospectively physiological pregnancies. When we related our data with calendar pregnancy date (calculated from LMP) we didn't find any correlation. Introducing biological scale related to the day of spontaneous labor we found minimum value on 3rd day before labor, negative correlation until this day and positive correlation in period from -3 day to the day of labor. The results of this preliminary cross-sectional study are of clinical and physiological importance.

## **Zusammenfassung**

Doppler-Messungen von foetalen und umbilikalischen Arterien im Verlauf der Schwangerschaft wurden in vielen bisherigen Studien durchgeführt. Diese Querschnittsuntersuchungen haben eine verstärkte

schwangerschaftsbedingte Abnahme des vaskulären Widerstands gezeigt und erlaubten die Einführung von Durchschnitts- und Grenzwerten der Doppler-Werte. Es gab eine Korrelation zwischen der Blutzirkulation und der Schwangerschaftsdauer. Diese Korrelation verschwand jedoch nach der 37. Schwangerschaftswoche. Diese Begrenzung wurde vermieden durch die Untersuchung bis zur 40. bzw. 42. Schwangerschaftswoche oder die Verwendung eines logarithmischen Maßstabs in der Schätzung der Regressionslinie. Trotz statistischer Tricks konnten die Untersuchungen in der fortgeschrittenen Schwangerschaft nicht als echte Querschnittsuntersuchungen betrachtet werden.

In der aktuellen Studie haben wir die Doppler-Messungen in der umbilikalen Arterie bei einer Gruppe von 70 fortgeschrittenen, bzw. physiologischen Schwangerschaften durchgeführt. Wenn wir unsere Daten mit kalendarischen Schwangerschaftsdaten (berechnet ab der letzten Menstruation) vergleichen, finden wir keine Korrelation. Durch die Einführung von biologischen Skalen bezogen auf den Tag der spontanen Geburt fanden wir minimale Werte am 3. Tag vor der Geburt, eine negative Korrelation bis zu diesem Tag und eine positive Korrelation im Zeitabschnitt vom 3. Tag vor der Geburt bis zum Tag der Geburt. Die Ergebnisse dieser vorläufigen Studie sind von klinischer und physiologischer Bedeutung.

## **Introduction**

Fetal and umbilical vessels' Doppler measurements in the course of pregnancy were performed in many previous studies<sup>2,4,6,7,10,15</sup>. It is commonly accepted that vascular resistance decreases during pregnancy. Previous investigations allowed to estimate the mean and range Doppler values in consecuted weeks of gestation calculated from LMP (menstrual gestational age). Those studies permitted to find out the correlation between flowmetric values and gestational age.

Unfortunately this correlation disappeared after 37th week of gestation. The authors of previous reports have overcome it by limitation of the examination time to 40th week of pregnancy or by use of the logarithmic scale in estimation of regression line.

Flowmetric profiles received in those studies are useful in high risk pregnancy monitoring, but they do not give us true physiological information about flowmetric changes in advanced pregnancy. The aim of this study is to measure one flowmetric parameter i.e. S/D ratio of umbilical artery in this critical period and relate these measurements to the day of spontaneous labor, according to biological scale<sup>11,12,13,14</sup>.

## **Material and Methods**

Total of 160 patients were taken into a scope. All of them were under biophysical monitoring including umbilical artery Doppler flow. The main reasons of mon-

itoring were as follows: post term pregnancy, unsuccessful course of previous pregnancies and status post cesarean section.

Subjects were selected for further analysis based on the following criteria: 1) no maternal and fetal complication in the course of pregnancy, 2) reliable dating of gestational age – regular menstrual cycle and certain last menstrual period (LMP), which was consistent with ultrasound estimates of gestational age, 3) gestational age 37 weeks or more at initial evaluation, 4) no fetal and/or neonatal morbidity including IUGR, prematurity or postmaturity.

Retrospectively 90 patients were excluded from the study because of the main reasons listed in Table 1.

**Table 1.** Exclusion criteria.

Induction of labor	46
Elective cesarean section	28
Signs of prematurity in newborn	3
Signs of postmaturity in newborn	13
Total	90

The studies were performed in three OB/GYN departments of neighbouring hospitals. Flowmetric measurements were obtained on three types of equipment i.e. Aloca SSD 280 + UGR 23, Hitachi EUB 565, Ultramark 4.

In the study group of 70 patients who fulfilled the criteria, 270 double measurements were taken according to method described in previous studies<sup>3</sup>. Pulsed Doppler wave was used to obtain S/D ratio in umbilical artery setting the sampling window near the fetal abdominal wall. Two recordings of at least 10 seconds of flow velocity waveforms were obtained for measurements.

## Results

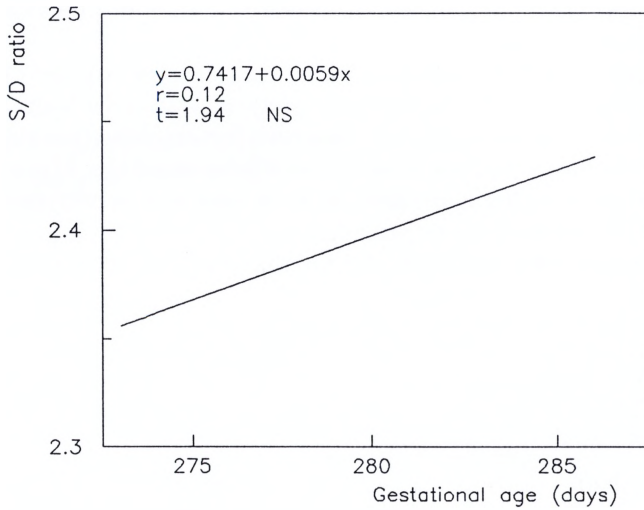
When we compared the S/D ratio values with calendar gestational age we received a very heterogenic pattern with slope going up without significant correlation ( $p = 0.1$ , Fig. 1). Retrospectively we constructed the other biological scale related to the onset of spontaneous labor. Transforming our previous data to this scale we received a slope going down with significant correlation (Fig. 2).

When we took into account mean values of S/D ratio in 6 consecutive days before spontaneous labor we recorded minimal value on the third day (-3 day, Fig. 3).

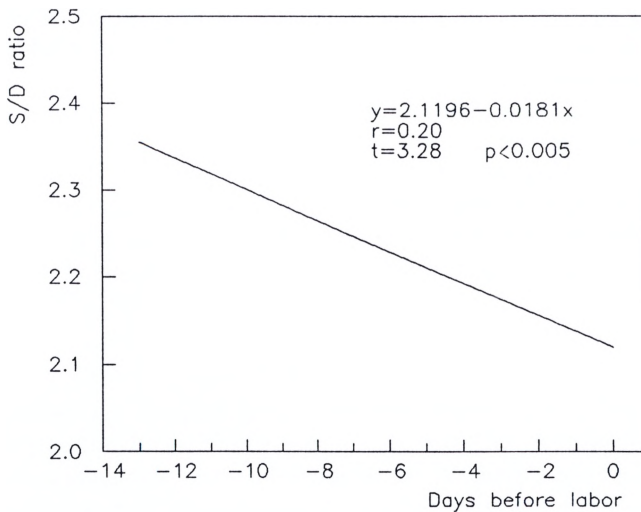
This value was significantly lower from -6 day value ( $p < 0.05$ ) and from the day of labor value ( $p < 0.05$ ).

Thus we constructed two new correlations: the first one illustrating the period until the third day before labor, the other from -3 day to the day of labor.

Not only the correlation in the first part was improved (Fig. 4), but also we found significant correlation with slope going up in the second part (Fig. 5).



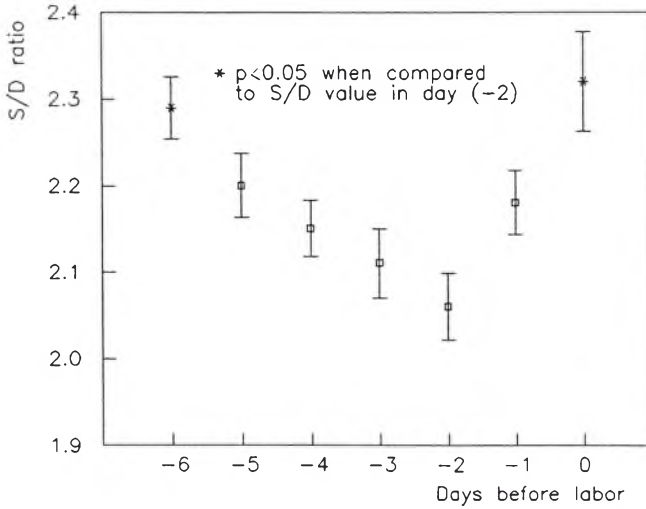
**Fig. 1.** Relationship between S/D ratio and calendar gestational age in group of 70 pregnant women (270 measurements).



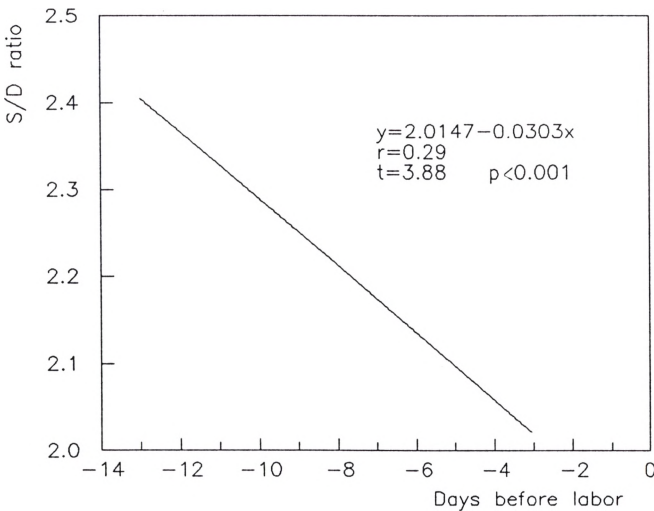
**Fig. 2.** Relationship between S/D ratio and time to spontaneous labor in group of 70 pregnant women (270 measurements).

## Discussion

Flowmetric scales dealing with many fetal and umbilical vessels reported in previous studies<sup>2,6,15</sup> are related to calendar gestational age. These scales are effective in monitoring of high risk pregnancies<sup>7,14,15</sup>, but according to our opinion they are not useful to assess physiological flowmetric changes in advanced pregnancy. It is difficult to correlate flowmetric data with very distant last menstrual

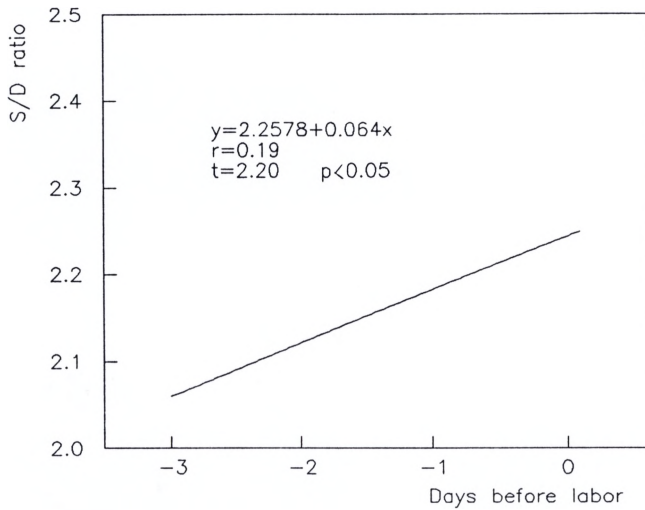


**Fig. 3.** Daily S/D ratio in group of 70 women in last six days before the spontaneous labor (178 measurements).



**Fig. 4.** Relationship between S/D ratio and time to spontaneous labor in group of 70 pregnant women (166 measurements – from 15th to 3rd day before labor).

period especially when we take into account natural biological changes in duration of pregnancy. Our preliminary report dealing with one flowmetric parameter i.e. S/D ratio estimated cross-sectionally is performed in advanced pregnancy. According to our best knowledge it is the first report about flowmetric measurements with use of biological scale related to initiation of parturition.



**Fig. 5.** Relationship between S/D ratio and time to spontaneous labor in group of 70 pregnant women (from 3rd day before labor to the day of labor).

Using this biological scale previously applied in enzymatic monitoring of pregnancy<sup>9,16</sup>, we confirm the well known fact of gestational decrease of S/D ratio in umbilical artery<sup>1,6</sup>. But our more in depth study revealed that this decrease reaches the minimum value on the 3rd day before labor. Then we observed gradual increase of S/D ratio up to day of spontaneous labor.

This increase was not connected with fetal distress because our potentially high risk study group retrospectively consists of patients with physiological course of pregnancy and labor<sup>5,8</sup>. Also this decrease does not seem to be connected with initiating uterine activity because it was found that umbilical artery flow remained unchanged during uterine constriction<sup>1</sup>.

Two conclusions of clinical importance can be drawn from our cross-section preliminary studies:

- 1) The decrease of S/D ratio in umbilical artery ensures us that labor should not initiate in next 2–3 days.
- 2) The increase in S/D ratio may be not only the ominous sign but also a physiological sign of approaching labor.

From physiological point of view the mechanism operating behind this decrease in S/D ratio in umbilical artery is not clear similarly like the mechanism of initiation of parturation. But we can suspect that the same changes preceding onset of labor for example some vasoactive substances or placental factors may be responsible for this increase. To elucidate this question further studies including Doppler measurements in other vessels are necessary. But our preliminary findings entitle us to present quite provoking speculation that the increase in placental resistance manifesting by S/D ratio increase may be an event in the cascade preceding the initiation of parturation.



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