

Umbilical artery S/D ratios and maternal systemic vascular resistance are correlated in patients at risk for preeclampsia.



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Introduction: Decreased umbilical artery diastolic flow, as evidenced by an increased systolic/diastolic flow velocity ratio (S/D ratio), is a hallmark of placental dysfunction and is often present in preeclamptic pregnancies. Defective placentation in preeclampsia is also associated with the production of “anti-angiogenic factors” such as sFLT-1 and soluble endoglin, which enter the maternal circulation and increase arteriolar tone and systemic vascular resistance. Using Doppler ultrasonography and electrical cardiometry (a new impedance cardiometry algorithm), we attempted to correlate umbilical artery S/D ratio and maternal systemic vascular resistance index (SVRI).

Materials and Methods: Seventeen patients at risk for preeclampsia were evaluated at 22-25 weeks gestational age with Doppler ultrasonography and electrical cardiometry (EC), to measure umbilical artery (UA) S/D ratio and maternal hemodynamics, respectively. The Cardiotron Aesculon EC system was used to measure mean arterial pressure (MAP), cardiac index (CI) and systemic vascular resistance index (SVRI) in three patient positions adopted during sonography: supine (SUP), 45 degrees, right decubitus (RDCUB) and 45 degrees, left decubitus (LDCUB).

Time spent in each position was approximately 5 minutes. Blood pressure was taken automatically by cuff on the patient’s left arm at least twice in each position and averaged. SVRI was computed from the CI, MAP and an assumed CVP = 6. Sampling time for CI was 10 seconds and values with a Signal Quality Index (SQI) > 60 were used.

Results:

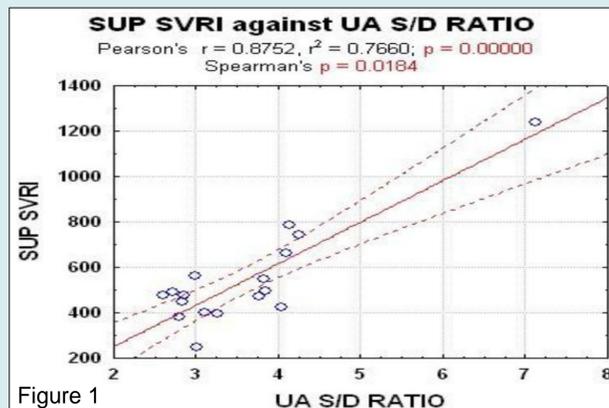


Figure 1

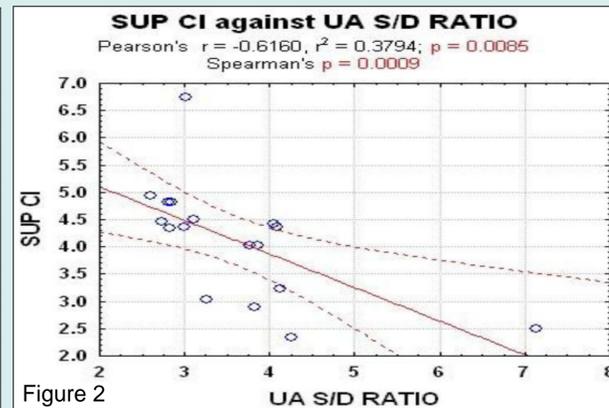


Figure 2

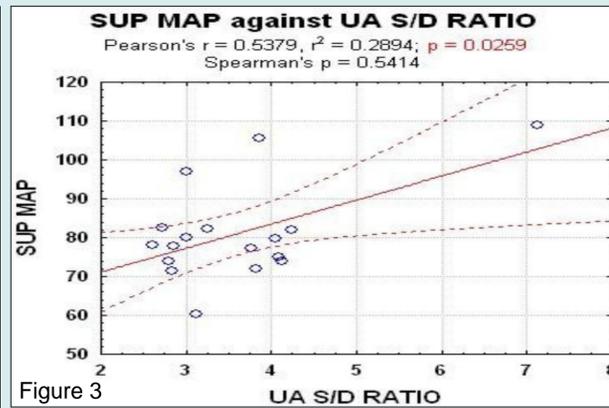


Figure 3

Figures 1-3: Higher umbilical artery S/D ratios are associated with higher systemic vascular resistance indices (SVRI) and lower cardiac indices (CI), but less associated with higher MAP.

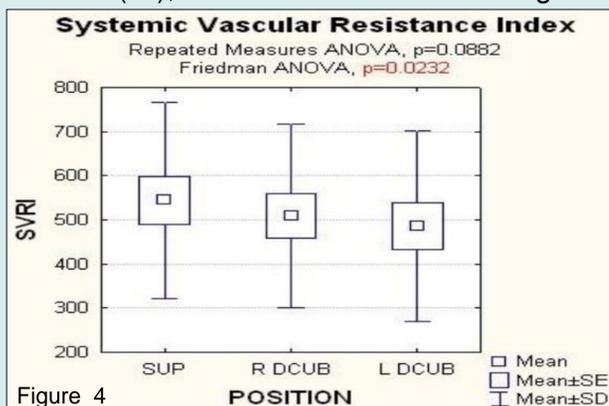


Figure 4

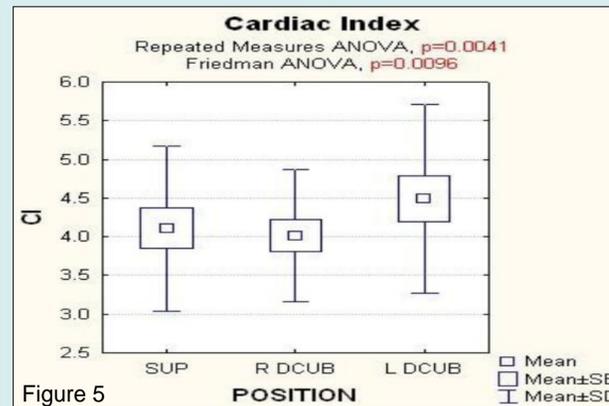


Figure 5

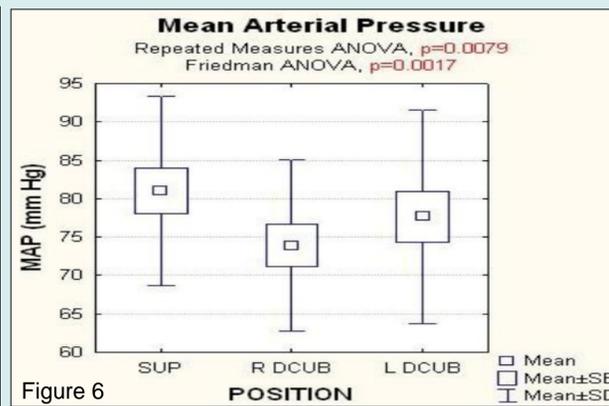


Figure 6

Figures 4-6: SVRI is lower and CI is higher in LDCUB than in other positions. MAP is highest in the supine position.

Discussion: We found a correlation between S/D ratio and maternal systemic vascular resistance index (SVRI) in 17 patients at risk for developing preeclampsia. Maternal supine SVRI and CI are significantly correlated with UA S/D ratio (**Figures 1-3**). This correlation is plausible since a diseased placenta may offer both increased resistance to the fetal circulation and release mediators which increase maternal SVRI. MAP is less correlated with UA S/D ratio, perhaps because of baroreceptor compensation.

We also found that patient position has a short term effect on maternal SVRI (**Figures 4-6**). SVRI is lower and CI is higher in the LDCUB position than in other positions. MAP is highest in the supine position. This short-term positional variation in SVRI may be due to activation of the sympathetic nervous system (SNS) by aortocaval compression, even at 22-25 weeks gestation.

We speculate that unrecognized ACC may confound attempts to use SVRI to predict or manage preeclampsia, since ACC may have the short term effect of increasing SVRI by activating the sympathetic nervous system, independently from any longer term effects of placenta-derived mediators on SVRI. We further speculate that, if SVRI is to be used as an index of maternal endothelial dysfunction, it may be best to measure SVRI in a position that minimizes ACC and SNS activation. That position usually will be the full left lateral decubitus position, or if that position is not feasible, the LDCUB position (45 degrees tilted to the left).

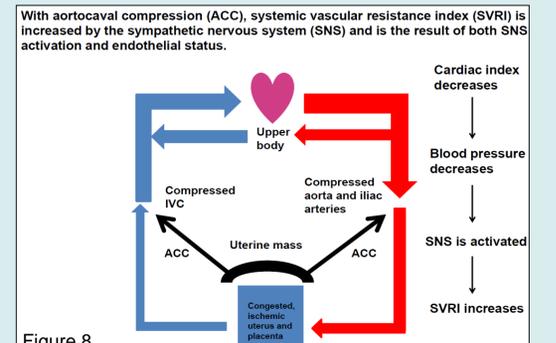


Figure 8

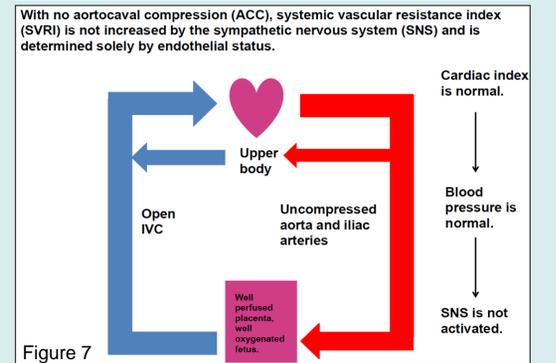


Figure 7