

Title: UMBILICAL ARTERY FLOW VELOCITY WAVEFORMS BEFORE AND DURING EPIDURAL ANESTHESIA FOR CESAREAN SECTION

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Introduction. Hollmen *et al* used xenon-133 to demonstrate increased intervillous blood flow (IBF) with epidural analgesia in healthy laboring women.¹ Subsequently, Marx and colleagues used Doppler ultrasound waveform analysis to demonstrate a significant reduction in umbilical artery vascular resistance (Systolic/Diastolic ratio) with epidural analgesia in healthy laboring women.² We have investigated the effect of more extensive epidural anesthesia (and maternal sympathetic blockade) on umbilical artery flow velocity waveforms in healthy, non-laboring women undergoing elective cesarean section.

Methods. Eighteen healthy women at term signed an informed consent approved by the Institutional Review Board prior to elective cesarean section. Left uterine displacement was employed throughout. Duplex ultrasound was obtained and a ranged-gated pulsed Doppler dropped at the level of the umbilical artery lumen at its placental insertion site. At least six cardiac cycles were printed, analyzed and averaged. Prior to induction of anesthesia each patient received a fluid preload of 1.5 - 2 L of lactated ringer's. For epidural anesthesia 20-25 ml 3% 2-chloroprocaine with epinephrine $1:3 \times 10^5$ were used. The intravenous infusion rate was adjusted to maintain systolic blood pressure above 100 torr. An upper level of sensory anesthesia to at least T4-s was confirmed before repeat umbilical waveform measurement. Paired Student's t test was used, with a p value of less than 0.05 to reject the null hypothesis.

Results. Waveform analyses of the paired studies were not statistically different from one another with respect to S/D ratio ($2.38 \pm .71$ before vs. $2.20 \pm .38$ during, mean \pm S.D.), Pourselot index ($.56 \pm .09$ vs. $.53 \pm .07$), pulsatility index ($.88 \pm .20$ vs. $.81 \pm .17$), area of the curve ($2.20 \pm .69$ vs. $1.96 \pm .33$ cm²), mean flow velocity ($30.8 \pm .86$ vs. $39.3 \pm .70$

cm/sec) and peak flow velocity (42.1 ± 12.5 vs. 47.5 ± 12.6 cm/sec).

Discussion. Jouppila and coworkers demonstrated no significant change in IBF with epidural anesthesia in healthy women undergoing elective cesarean section.³ We have used Doppler ultrasound to demonstrate no statistically significant change in umbilical artery resistance (S/D ratio) under the same circumstances. In light of the fact that these women were healthy and not in labor, it is perhaps not surprising that no significant hemodynamic improvements were found. Inversely, it is reassuring that, provided hypotension is avoided by appropriate circulatory preload, both investigational techniques confirm that epidural anesthesia for cesarean section has no deleterious effect on fetoplacental circulation. In contrast, Jouppila *et al* found a significant reduction in IBF after induction of general anesthesia for elective cesarean section.⁴ Waveform analysis should be applied here to corroborate this apparent advantage (in fetoplacental circulation) of epidural over general anesthesia for elective cesarean section.

References. 1. Hollmen A, Jouppila R, Jouppila P, *et al*: Effect of extradural analgesia using bupivacaine and 2-chloroprocaine on intervillous blood flow during normal labor. *Br J Anaesth* 54:837, 1982. 2. Marx G, Patel S, Berman J, *et al*: Umbilical blood flow velocity waveforms in different maternal positions and with epidural analgesia. *Obstet Gynecol* 68:61, 1986. 3. Jouppila R, Jouppila P, Kuikka J, *et al*: Placental blood flow during caesarean section under lumbar extradural analgesia. *Br J Anaesth* 50:275, 1978. 4. Jouppila P, Kuikka J, Jouppila R, *et al*: Effect of induction of general anesthesia for cesarean section on intervillous blood flow. *Acta Obstet Gynecol Scand* 58:249, 1979.