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Correlation between fetal liver blood flow and neonatal adiposity in gestational diabetes mellitus and fetal growth restriction

Bachani S, Dadhwal V, Deka D, Sharma A, Bhawana
All India Institute of Medical Sciences, Delhi, Delhi, India

Objective

To determine if fetal hepatic blood flow at 34-36 weeks of gestation is associated with neonatal adiposity in uncomplicated pregnancies and in those with gestational diabetes mellitus (GDM) and fetal growth restriction (FGR).

Methods

It was a prospective observational study. Eighty women with singleton pregnancy attending the antenatal clinic were recruited after an informed consent. Group A comprised of 40 women with uncomplicated pregnancies, Group B was 20 women with gestational diabetes mellitus (GDM) and Group C comprised of 20 women with fetal growth restriction (defined as fetal weight less than 10th centile). Antenatal data including pre pregnancy BMI was recorded in all women. An obstetric ultrasound and Doppler study was done at 34-36 weeks of pregnancy. Complete biometry and Doppler parameters for umbilical artery, middle cerebral, ductus venosus and umbilical vein was measured, a mean of three values calculated. Ultrasound examinations were performed with Toshiba Xario 200 in digital imaging and color and pulsed-wave Doppler mode. The time-averaged maximum velocity was calculated for UV, and DV as (Vmax) UV and (Vmax) DV. Blood flow (Q) as Q= h x (D/2)2 x p x TAMX (D= vessel diameter, h= spatial blood velocity profile coefficient (UV= 0. 5; DV= 0. 7)). Percentage (%) shunting was calculated as ratio DV flow/UV flow and liver blood flow as UV flow – DV flow. Neonatal adiposity was measured by Brooks formula for males as M: d = 1. 1690 – 0. 0788 x log SFT (sum of all skin fold thickness) and in females as F: d = 1. 2063- 0. 0999 x log SFT. Outcome measures were fetal hepatic blood flow and DV shunting in uncomplicated pregnancies and in those with GDM & IUGR and correlation of fetal hepatic blood flow with neonatal adiposity. The MCA and umbilical artery PI measurements were correlated for evidence of brain sparing in relation to altered liver blood flow.

Results

Average maternal age was 29. 4+_ 6. 8yrs. Average BMI in normal, GDM and IUGR pregnancies was 27. 4, 29. 6, and 24. 6 respectively. The mean birth weight was 2. 9+_0. 8 kg in group A, 3. 4+_0. 4kg(p 0. 04) in group B and 2. 3+_0. 5 kg in group C. The diameter of Umbilical vein and Ductus venosus was comparable in all the three groups. The fetal hepatic blood flow was 66. 8 +_ 9. 5 ml/min in the group A, 68. 4+_7. 5ml/min in the group B and 63. 4+_3. 8 ml/min in group C. The DV shunting was 22. 5 % in group A, 23. 5% in group B (p 0. 706) and 35. 4% in group C (p 0. 04). Raised umbilical artery PI and brain sparing had a significant association with severe IUGR (Fetal AC <5th centile). Neonatal body fat percentage was 14. 5+_3. 5% in group A (0. 006), 18. 8+_2. 8% in group B and 13. 4+_2. 6% in group C(0. 046) which correlated with the respective hepatic blood flow in group A and C. DV shunting correlated positively (p 0. 03) with the percentage increase in neonatal adiposity only in lower values of MCA PI below 2. 6 in all the groups however with CPR <1 the degree of DV shunting was significantly increased.

Conclusion

There is a significant association between fetal hepatic flow and neonatal obesity in women with normal pregnancies and with IUGR. Higher body fat percentage in neonates of diabetic mothers had no significant correlations with the hepatic blood flow; the higher fat accretion could be due to increased levels of fatty acids and triglycerides in the maternal blood transported to the fetus via the placenta. Ductus venosus shunting was significantly higher in fetuses where CPR was less than one, thus a hypoxic fetus compromises on deposition of substrate to improving cerebral blood flow.