

Effects of Maternal Position on Placental Blood Flow and Oxygen Transfer in Fetal Growth Restriction - an MRI study.

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Background:

Supine going-to-sleep position is an independent, modifiable risk factor for late stillbirth, with a greater risk of fetal growth restriction (FGR). The effect of supine position on fetal oxygenation has not been investigated in FGR pregnancies.

Aims:

1. To investigate maternal-placental and fetoplacental blood flow, placental oxygen transfer and fetal oxygenation in FGR, compared to healthy pregnancies.
2. Quantify the effect of maternal supine position on the above outcomes in normal and FGR pregnancies

Method:

12 FGR and 27 normal pregnancies at 34-38 weeks gestation

Participants underwent Phase Contrast MRI and Diffusion-Relaxation combined MRI (DECIDE) in supine and left-lateral decubitus (LLD) position – total 25 min

MRI images analysed to calculate:

- Maternal Total Internal Iliac Artery (TIIA) Blood Flow
- Umbilical Venous (UV) Blood Flow
- Fetal Oxygen Saturation (FO₂)
- Placental Flux – oxygen transfer (Diffusivity x FO₂)
- Delivery Flux – fetal oxygen delivery (UV Flow x FO₂)

Results:

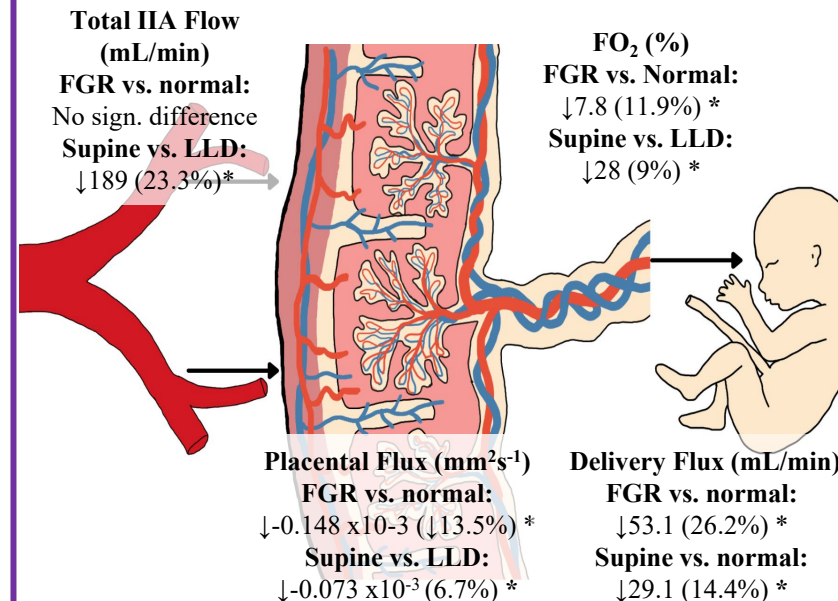
1. FGR compared with normal pregnancies:

TIIA Flow	No significant difference (p=0.40)
UV Flow	56 mL/min lower (18%, p=0.008)
FO ₂	7.8% lower (12%, p=0.02)
Placental Flux	0.148 x10 ⁻³ mm ² s ⁻¹ lower (14%, p=0.03)
Delivery Flux	53 mL/min lower (26%, p=0.0004)

2. Supine compared with LLD position:

TIIA Flow	189 mL/min reduction (23%, p<0.0001)
UV Flow	28 mL/min reduction (9%, p=0.01)
FO ₂	3.8% reduction (6%, p=0.001)
Placental Flux	0.073 x10 ⁻³ mm ² s ⁻¹ reduction (7%, p=0.01)
Delivery Flux	29 mL/min reduction (14%, p=0.0007)

The effects of supine position on TIIA flow, UV flow, FO₂ and Delivery Flux were independent of whether the participant had a normal or FGR pregnancy.



Conclusion:

- MRI is a useful method of non-invasively quantifying fetal oxygenation and placental function in FGR pregnancy
- In FGR, there is a significant reduction in FO₂, placental oxygen transfer and fetal oxygen delivery compared to healthy pregnancies.
- Maternal supine position causes acute fetal hypoxaemia, and growth-restricted fetuses are more vulnerable to this stressor due to their chronic hypoxaemia.
- This explains why FGR pregnancies have a higher risk of unexplained late stillbirth.