

Title:**An Image Processing Technique for the Visualization and Quantification of Blood Flow Entering the Placenta using 3D power Doppler Ultrasound (PD-US)****Objectives**

Inadequate spiral artery (SA) transformation has been implicated in adverse pregnancy outcome. A method to study its development *in-vivo* that is fast, repeatable and accurate has yet to be established. In this work we propose an image processing method to solve this problem.

Methods

An image analysis technique was developed to examine the vascularity of the placenta at set distances from the utero-placental interface (UPI) in 3D using PD-US. The resulting 3D surfaces provide a “virtual biopsy” enabling the blood flow entering the placenta to be visualised and measured. The imaging method (Fig 1) identified for all voxels in the placenta their distance from the UPI. Then voxels at set millimetre distances from the UPI (2mm to 5mm) were extracted and visualised as a mesh. For each mesh the number and area of jets shown by PD signal entering the IVS at corresponding depths were analysed (Fig. 1f).

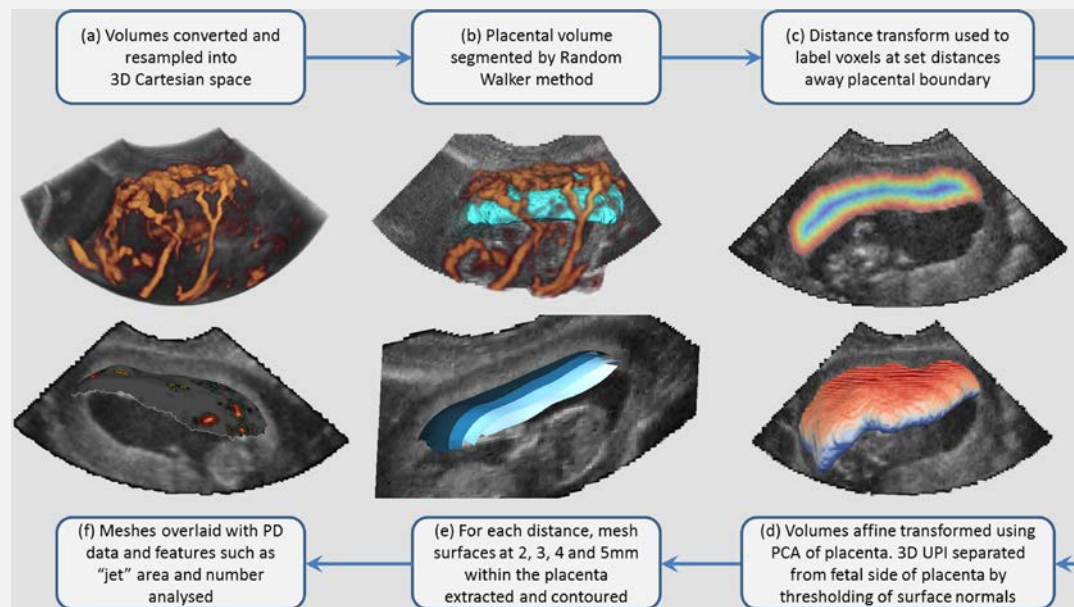


Figure 1 - Workflow of image processing method for measurement of jet number and area using 3D PD-US at specific distances from the UPI.

Results

In 120 pregnancies, measurements were made at distances 2 to 5mm from the UPI. All features showed significant differences the further the surface was away from the UPI (K-W test; $p < 0.001$). Mean jet number decreased from 17.3 at 2mm to 6.2 at 5mm. Jet area (cm^2) decreased from 7.8 at 2mm to 2.1 at 5mm. Repeatability between automated and manual counting of jet number was excellent (intra-class correlation co-efficient > 0.93).

Conclusion

This method provides a new *in-vivo* tool for examining spiral artery development which may facilitate a better understanding of the underlying pathology in adverse pregnancy outcome. This data could be used to identify placentas with pathologically smaller numbers or total area of the jets, providing a new imaging biomarker for placental insufficiency.