THREE-DIMENSIONAL VISUALISATION AND ANALYSIS OF FETO-PLACENTAL VASCULAR CAST USING MICRO-COMPUTED TOMOGRAPHY IN A RAT MODEL

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Many studies of the feto-placental vascular structure have utilised a range of two-dimensional (2D) and three-dimensional (3D) imaging techniques including ultrasound, electron microscopy, confocal microscopy and stereological techniques on systematic uniform random sections; and most recently, innovation with X-ray microtomography (micro-CT) with perfusion of radio-opaque compounds. The CT approach has been used to study feto-placental vasculature in mouse [1], rat [2] and human [3]; this approach embodies particular advantages: (i) revealing the 3D structure in high resolution and (ii) permitting multiple rescanning without irreversibly destroying the sample casts. Nevertheless, some challenges with the micro-CT approach still remain: technically demanding preparation of Microfil casting samples and manual segmentation of the vasculature.

In this study we present methodology for 3D visualisation of the feto-placental arterial vascular tree by 3D high-resolution micro-CT scanning in a rat model. The methodology includes 3 steps. Firstly, casting generation of feto-placental arterial network by using Microfil, which is a radio-opaque yellow silicone rubber contrast agent (Microfil, FlowTech Inc., Carver, MA, USA). Secondly, 3D high-resolution micro-CT scan using the Xradia 520 Versa micro-CT scanner (Xradia 520 XRM, ZEISS, Oberkochen, Germany) and 3D image reconstruction using the XMReconstructor and XM3DViewer software (Zeiss, Oberkochen, Germany). Thirdly, automatically segmentation of the network in the reconstructed images using Amira 6.2.0 (Thermo Fisher Scientific, Hillsboro, Oregon, USA). Finally, we demonstrated 3D high-resolution visualisation and analysis of the feto-placental arterial network in rat. This 3D visualisation methodology has the potential to elucidate detailed information on vascular connectivity and crucial understanding of vascular structure.

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