Contribution ID: **28** Type: **not specified**

Visualising Human Endometrial Gland Epithelial Cells in 3D Using Serial Block Face Scanning Electron Micrographs

Background: The endometrium is the lining of the uterus and is where embryo implantation occurs. Successful implantation requires a suitable endometrial microenvironment, created in part by endometrial glands. Failure to implant leads to subfertility and could be due to endometrial gland dysfunction, however Glandular Epithelium (GE) is poorly understood.

Aims: The project aims to produce novel 3D reconstructions of human GE and to quantify cell measurements.

Methods: Previously imaged Serial Block Face Scanning Electron Micrographs of endometrial GE during the window of implantation from women who had undergone successful pregnancies were segmented in TrakEM2, Fiji to produce 2D labels. These labels were exported into Avizo and turned into 3D images, which were quantitated to extract data from cells and nuclei, including volume, surface area, length, nuclear volume as a percentage of cell volume, the length between nuclei and basal lamina, and angle between cell and basal lamina. SPSS, Prism and Excel were used to analyse the data.

Results: This project produced 3D images of 9 pseudostratified and 3 columnar endometrial GE (figure 1). Quantification of these cells and their nuclei showed the average volume of pseudostratified cells to be 985.3 ± 393 μm3 and 989.5 ± 74.8 μm3 for columnar cells. The average surface area of pseudostratified cells was 1050.1 ± 425 μm2 and 1050.1 ± 121.6 μm2 for columnar cells. There was no significant difference found between any data extracted from both cell types. In addition, quantification allowed us to assess the spatial relationship between the cells.

Conclusion: This project has 3D imaged endometrial GE and quantitated them for the first time. It demonstrates how 3D imaging can provide additional insight into tissue structure than has been possible by 2D imaging techniques. This approach can now be applied to sub fertile endometrium and identify potential causes of conditions such as subfertility and infertility.

Word count:
Title: 15 words
Body of the Abstract: 300 words

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Session Classification: Poster Session & Fingerfood