TECHNISCHE HOCHSCHULE DEGGENDORF

ADPKD

SCHLAGEN EINER BRÜCKE ZWISCHEN DEN EXPERIMENTEN AN TIER UND MENSCHEN MIT HILFE DES 3D-IN-VIVO MODELLS IN DER FORSCHUNG DER AUTOSOMAL DOMINANTEN POLYZYSTISCHEN NIERENERKRANKUNG (ADPKD).

TRR 374

Weitere Infos

Title:

Human polycystic renal tissue perfusion visualized by high frequency ultrasound in a 3D-in-vivo model

Background

Autosomal dominant polycystic kidney disease (ADPKD) is a monogenetic kidney disease characterized by the presence of cysts in both kidneys. With an incidence of 1:1000 it is the most common hereditary kidney disease in the world. We have recently shown that human polycystic kidney tissue can be cultivated on the chorioallantoic membrane (CAM) for the first time. One central aspect of this innovative model is the vitality of the tissue which strongly depends on adequate blood perfusion. Ultra high frequency ultrasound enables the visualization of smallest structures that cannot be detected by conventional ultrasound. Here we propose UHF imaging as a new imaging technique in a 3D-in-vivo model to acquire new insights into tissue perfusion and survival.

Methods

Human renal cystic tissue was incubated on the CAM and examined using UHF ultrasound imaging. Due to the unprecedented resolution of UHF, we have managed to visualize microvessels, their development, and the formation of anastomoses. This allowed us to observe the connection of human and chicken vessels only 12 hours after transplantation. The new method and the observations described with it were validated by 3D reconstructions from a light sheet microscopy image stack, indocyanine green angiography, and histological analysis.

Results

Histological results showed numerous chicken erythrocytes within the human cystic tissue at the end of the incubation period of 7 days. Based on the distribution of active blood vessels detected by UHF ultrasound, corresponding functional anastomoses between chicken vessels and human vessels were detected as early as 12 hours after grafting the human renal cystic tissue onto the CAM. These results could be confirmed by 3D reconstructions.

Conclusion

Contrary to the assumption that the nutrient supply of the human cystic tissue and the gas exchange happens through diffusion from CAM vessels, this study shows that the vasculature of the human cystic tissue is directly connected to the CAM network, and blood flow is established within a short period. Therefore, this in-vivo model combined with UHF imaging is ideally suited for studying the effects of intravenously applied therapeutics on renal cyst growth.

Project Participants:

Jan Schueler[1,7], Jonas Kuenzel[1] Anna Thuesing[1], Eric Pion[1], Rose Behncke[2], René Haegerling[2], Dieter Fuchs[3], Boqiang Huang[4], Dorit Merhof[4], Andre Kraus[5], Bjoern Buchholz[5], Katharina Schmidt[6], Christina Hackl[6], Thiha Aung[7], Silke Haerteis[1]

[1]University of Regensburg
Faculty for biology and preclinical medicine
Institute of molecular and cellular anatomy

[2]Chartie Berlin
Berlin Institute of Health at Charite-Universitätsmedizin Berlin

[3] FUJIFILM VisualSonics Inc.

[4]University of Regensburg
Institute of computer science and data science
Chair of image processing

[5]University Hospital Erlangen
Department of Nephrology and Hypertension

[6]University Hospital Regensburg
Department for Surgery

[7]Deggendorf Institute of Technology
Faculty for Applied Healthcare Sciences

Project Partner:

Deggendorf Institute of Technology

University of Regensburg

FUJIFILM VisualSonics Inc.

University Hospital Erlangen

University Hospital Regensburg

Charite Berlin

Funded by:

BayWISS

Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), project number 509149993, TRR 374

Logos: