



Vascularized pancreatic islet-on-chip for type 1 diabetes

Emily Tubbs, Clément Quintard, Amandine Pitaval, Joris Kaal, François Boizot, Yves Fouillet, Fabrice Navarro, Xavier Gidrol

► To cite this version:

Emily Tubbs, Clément Quintard, Amandine Pitaval, Joris Kaal, François Boizot, et al.. Vascularized pancreatic islet-on-chip for type 1 diabetes. EUROocs 2024 - EUROoCS Annual Meeting 2024, Jul 2024, Milan, Italy. hal-04399755

HAL Id: hal-04399755

<https://hal.science/hal-04399755>

Submitted on 17 Jan 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Vascularized pancreatic islet-on-chip for type 1 diabetes

Emily Tubbs^{1*}, Clément Quintard², Amandine Pitaval¹, Joris Kaal³, François Boizot³, Yves Fouillet³, Fabrice Navarro³ and Xavier Gidrol¹.



¹ Univ. Grenoble Alpes, CEA, Inserm, IRIG, BIOMICS, 38000 Grenoble, France.

² Department of Medical genetics, Life Sciences Institute, University of British Columbia, Canada.

³ Univ. Grenoble Alpes, CEA, LETI, 38000 Grenoble, France.

*e-mail: emily.tubbs@cea.fr

Diabetes is a growing threat to global health, currently affecting 537 million people worldwide, or 1 in 10 adults. The World Health Organization predicts that 783 million people will suffer from diabetes in 2045. Diabetes, type 1 or 2, cause an abnormal and prolonged increase of the blood glucose level, mainly caused by deficiency or failure to use insulin. In the long term, diabetes can lead to many complications, including vasculopathy, neuropathy, retinopathy, and diabetic foot ulcer. There is a need to understand the mechanisms of action in a human model in order to finely-tune the treatment for each patient. Building *in vitro* analytical tools is crucial to model the complexity of physiology and pathophysiology of pancreatic islets for a better understanding of its basic biology as well as for the screening of new drugs. While most common perfusion systems require pooling of multiple islets to achieve quantifiable insulin concentrations, minimizing the number of islets required for experiments using microfluidic platforms is important given the scarcity of these biological tissues.

We have previously designed and validated a microfluidic device integrating a network of hyper-elastic valves for automated glucose stimulation and insulin collection from a single pancreatic islet [1]. Here, we used the same serpentine chip design and cultured human beta cells spheroids composed of EndoCBH5 cells (from Human Cell Design©), in a fibrin gel enriched in endothelial cells and fibroblasts. Thus, we tested the effect of flux, and of an enriched vascular microenvironment on the functionality of the human beta cells spheroids. A glucose stimulated insulin secretion assay was performed and we observed an improved functionality of the human beta cells spheroids with both the flux and the enriched microenvironment. Our results confirm that recreating a favorable pancreatic islet niche significantly improves functionality [2].

Our results pave the way to personalized medicine for the study of diabetes. The perspectives offered by this islet-on-chip model are considerable and promise to be beneficial to patients.

References

[1] Quintard C, Tubbs E, Achard JL, Navarro F, Gidrol X, Fouillet Y. *Microfluidic device integrating a network of hyper-elastic valves for automated glucose stimulation and insulin secretion collection from a single pancreatic islet*. Biosens Bioelectron. 2022 Apr 15;202:113967.

[2] Quintard C, Tubbs E, Jonsson G, Jiao J, Wang J, Werschler N, Laporte C, Pitaval A, Bah T, Pomeranz G, Bissardon C, Kaal J, Leopoldi A, Long D, Blandin P, Achard J.-L, Battail C, Hagelkruys A, Navarro F, Fouillet Y, Penninger J, Gidrol X. *A microfluidic platform integrating functional vascularized organoids-on-chip*. Nature Communication, in press.