

RESEARCH TOPIC PRIME1

Cholangiocarcinoma-on-chip: from molecular pathogenesis to precision medicine

Thematic field of the project

Bioengineering

Research Supervisor

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Main facility

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Other facility

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Main field of interest

Organ-on-Chip (OoC).

OoC technology combines the use of microfluidics, biomaterials, and advanced cell cultures in order to generate and monitor miniaturized replicas of human tissues and organs in vitro. It is an enabling technology involving interdisciplinary expertise from the fields of engineering, physics, and cell/molecular biology. Application areas include environmental assessment, toxicological evaluation of chemical agents, drug screening and disease modeling, among others

Abstract

Cholangiocarcinoma (CCA) is a deadly cancer of the biliary epithelium. It is frequently diagnosed at advanced stages, it is highly chemoresistant, and pharmacological therapies are generally unsuccessful. The combination of immune checkpoint inhibitors plus chemotherapy significantly prolongs survival. We recently developed an innovative patient-specific CCA-on-chip platform that integrates the major components of the tumor microenvironment and faithfully mimics the CCA niche.

Aim:

to validate the use of a patient specific CCA-on-chip to unravel the mechanisms underlying response to immunotherapy, and for drug screening in CCA.

Experimental Design:

1. dissection of the effects of chemo-immunotherapy on T-cell phenotypes and treatment response in CCA
2. “proof of concept” study to investigate the potential role of patient specific CCA-on-chip to predict response to therapy.
3. definition of 3D bioprinting protocols for CCA-on-chip to develop a standardize model for scalable production.

Main technical approaches

Experience in the design of microfluidic devices and microfabrication techniques; skills in numerical modeling (e.g., COMSOL); familiarity with 3D cell cultures, imaging techniques, and functional analysis; interest in the integration of control algorithms and artificial intelligence.

Scientific references

- Polidoro MA, Ferrari E, Soldani C, et al. Cholangiocarcinoma-on-a-chip: A human 3D platform for personalised medicine. JHEP Rep 2024
- Alvisi G, Termanini A, Soldani C, et al. Multimodal single cell profiling of intrahepatic cholangiocarcinoma defines hyperactivated Tregs as a potential therapeutic target. J Hepatol 2022
- Polidoro MA, Ferrari E, Marzorati S, Lleo A, Rasponi M. Experimental liver models: From cell culture techniques to microfluidic organs-on-chip. Liver Int 2021
- Mapping the landscape of biliary tract cancer in Europe: challenges and controversies. Rimassa L, Khan S, Groot Koerkamp B, et al. Lancet Reg Health Eur. 2025

Type of contract

PhD scholarship of € 21.000 gross per year awarded by Humanitas University. This sum is exempt from IRPEF income tax according to the provisions of art. 4 of Law no. 476 of 13th August 1984, and is subject to social security contributions according to the provisions of art. 2, section 26 and subsequent sections, of Law no. 335 of 8th August 1995 and subsequent modifications.

Borsa di dottorato pari a € 21.000 annui lordi erogata da Humanitas University. Importo non soggetto a tassazione IRPEF a norma dell'art. 4 della L. 13 agosto 1984 n. 476 e soggetto, in materia previdenziale, alle norme di cui all'art. 2, commi 26 e segg., della L. 8 agosto 1995, n. 335 e successive modificazioni.