BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

Ateneo/DIMEAS - Engineered in vitro models of human cardiac fibrosis for the in vitro testing of RNA therapies

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Context of the research activity	Progressive aging of world population increases the demand for new advanced therapies against age-related diseases, such as cardiac disorders. Predictive in vitro models of human cardiac fibrosis are demanded to facilitate the development of new therapeutic approaches, including RNA therapies. Their successful exploitation requires multidisciplinary research efforts, including bioengineering tools (nanoparticles, hydrogels, tissue models).
Objectives	The PhD student will develop in vitro models of human cardiac fibrosis through biomaterial design, scalable manufacturing approaches and proper cell co-cultures. The models will be validated by accurate physicochemical and biological characterization. Novel RNA-therapeutics will be tested in the models, exploiting non-viral delivery systems, including commercial and newly developed nanoparticles. Methods to assess dose-dependent safety and efficacy will be optimised in the models. The co-release of other bioactive molecules will be also tested for a synergic approach. Scaffold design and functionalization, cell co-cultures, hydrogels and nanomedicine approaches will be combined to achieve the following aims: (1) Design of biomimetic scaffolds for the in vitro modelling of human cardiac fibrotic tissue by proper cell co-cultures. (2) Development of methods to test RNA therapies in the models (in collaborations with other international research groups). (3) Design of nanocarriers to target specific cardiac cells. (4) Design of injectable hydrogels, able to preserve drug bioactivity, control release kinetics, support tissue-specific action (potential collaboration with expert clinicians). (5) Study of regulatory requirements, sterilization and scale-up (potential collaboration with research centers/companies); The aim is to develop predictive in vitro models of human cardiac fibrosis and

	validate new RNA therapies to treat cardiac diseases, by accurate design of new effective and simple drug delivery approaches. Other patients' need will be considered such as the need for improved administration routes, by designing hydrogels for single implantation (through mini-invasive application). The research activity will cover 2 of the missions of the National Recovery and Resilience Plan (PNRR): 4. Education and research, supporting the formation in STEM disciplines, and 6. Healthcare, as the research will be focussed on the design of in vitro pathological tissue models for preclinical testing and validation of advanced therapies for cardiac regeneration and/or modulation of cardiac fibrosis. Furthermore, the activity is partially supported by National Center for RNA & Gene Therapy.

Skills and competencies for the development of the activity	We are looking for talented and motivated candidates, preferably with skills/experience in: - Tissue engineering - Nanomedicine - In vitro cultures and cell tests Excellent communication skills and good knowledge of written English and spoken English are required. The PhD student will work in a multidisciplinary team: team-working and willingness to learn new techniques/methods are required.