심혈관 환자맞춤형 차세대 정밀의료기술 선도연구센터(RLRC)
2단계 2차년도 정기세미나

❍ **일정** : 2025년 04월 23일(수), 16:30~17:30

❍ **연사** : 고려대학교(세종) 디지털헬스케어공학과 김승규 교수

❍ **주제** : 미세생리시스템-디지털트윈 통합모델 기반 피하약물분포 예측 연구

❍ Abstract :

Subcutaneous (SubQ) injection is an increasingly common route for administering biopharmaceuticals, particularly monoclonal antibodies. However, predicting the bioavailability and pharmacokinetics of drugs administered subcutaneously remains challenging due to the complex nature of the subQ environment. In recent years, several in vitro models (e.g., SCISSOR, ESCAR) have been developed to simulate the subQ space and predict drug behavior following injection. These models aim to provide a cost-effective and ethical alternative to animal studies, which often fail to accurately predict human outcomes for subQ delivery.

The essential steps in subQ drug transport that we aim to address include: the initial distribution of the drug in the subQ space immediately following injection, its convective and diffusive transport through the extracellular matrix, binding and release from matrix molecules, uptake, degradation, and release kinetics of resident cells, and entry into the blood and lymphatic vasculatures, followed by systemic circulation to the intended site of action.

In this study, we introduce a hybrid system combining microphysiological systems (MPS) and digital twin (DT) technology, referred to as MPS-DT, to predict the biodistribution of peptide drugs in the subQ space and their absorption into systemic circulation. We sought to identify the key parameters governing subQ pharmacokinetics and develop various MPS systemsto measure them. Additionally, we developed a DT-based computational framework that simulates subQ drug transport physiology by integrating MPS-derived key parameter data. By incorporating these experimental and computational tools, our work provides a novel framework for predicting subQ drug transport and absorption, with implications for optimizing formulation strategies and improving translational relevance to human physiology. This study represents the first comprehensive approach that integrates experimental MPS data with digital twin modeling for subQ drug delivery, offering a powerful tool for pharmaceutical research and development.