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Terry Papoutsakis
University of Delaware

Jinlin Jiang
University of Delaware

Chen-YUan Kao

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E. Terry Papoutsakis (*speaker*), Jinlin Jiang & Chen-Yuan Kao
Department of Chemical & Biomolecular Engineering
University of Delaware, Newark, DE 19711, USA

Mammalian cells release into the extracellular environment microparticles (MPs; less than 1 micron) under some stress or activation process. MPs result from direct budding off the plasma membrane, and are important in intercellular communication by transferring RNA, proteins, and lipids between cells. Cells endow their MPs with signaling or functional molecules, to target specific cell types. They enrich their MPs in specific miRNAs, piRNAs, and long ncRNAs to program or reprogram target cells towards functional differentiation or specific cellular actions. Cells also use MPs to get rid of "death molecules", and/or promote cell survival and "renewal" of target cells. We will discuss the characterization and potential applications of MPs from two biological systems: megakaryocytic MPs (MkMPs) derived from human hematopoietic stem and progenitor cells (HSPCs) and CHO-cell MPs (ChocMPs).

Megakaryocytes (Mks) derive from the differentiation of HSPCs in the bone marrow, and as they mature, they achieve high-ploidy status. Platelets are produced from polyploid Mks under the action of biomechanical forces. We showed that mature Mks also shed MkMPs, whose generation is dramatically enhanced by shear flow. Co-culture of MkMPs with HSPCs promotes HSPC differentiation to Mks without exogenous thrombopoietin (the growth factor that stimulates Mk production from HSPCs), thus identifying a novel and previously unexplored physiological role for MkMPs. We show that MkMPs target HSPCs with exquisite specificity, and discuss mechanisms by which MkMPs target and act upon HSPCs. We argue for using MkMPs for regenerative-medicine applications, notably for the treatment of thrombocytopenia, as well as in as vectors for delivering nucleic-acid and protein "cargo" to HSPCs.

The mechanism and kinetics of ChocMP generation and their biological role remain unexplored. We will discuss the first characterization of ChocMPs by examining the kinetics and mechanism of formation, their RNA content and efforts to identify their functional role. CHO cells produce ChocMPs from the very beginning of the culture, with different kinetics for attached versus suspension CHO cells. E.g., in suspension culture, ChocMPs concentration decreases with culture progression, thus suggesting that ChocMPs are fused into or endocytosed by CHO cells. In attached CHO cells, ChocMP generation is associated with "star- or bubble-studded" cellular images, characteristic of tumor-cell MP generation, thus providing first clues as to of the role of ChocMPs, since tumor-cell MPs have rather unique make up and role. ChocMP generation is promoted by stationary-phase conditions (notably, serum starvation), and biomechanical forces. Based on paradigms from other cells, we envision using ChocMPs as a means to predict culture fate, identify the role of small RNAs they are enriched in, and enhance culture performance.