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Effects of Fluid Flow on Murine Embryonic Stem Cells

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Abstract

Embryonic stem cells are cells with the ability to make more of themselves (self-renew) and to produce all the cells of the body (pluripotency). These abilities give embryonic stem cells much value to study for medical applications, such as regenerative medicine for treating damaged tissues. However, a large number of specific types of cells are required for tissue therapy. Thus embryonic stem cells must be expanded and differentiated in a controlled manner. In order to better control embryonic stem cells, the cell signalling pathways responsible for cell behaviour must be understood. Cell signalling is the molecular chain of events that occurs due to a stimulus in the environment. From previous studies examining embryonic stem cell behaviour under fluid flow conditions in spinner flask bioreactors, it was found that pluripotency markers were maintained even in media that should lead to cell differentiation into other cell types. We hypothesized that several key signalling pathways triggered by shear stress were responsible for this behaviour. To test this hypothesis, mouse embryonic stem cells were placed in parallel plate flow chambers and exposed to uniform fluid shear stress. These embryonic stem cells were previously transfected with a reporter construct that detects β-catenin activity, which is related to pluripotency of stem cells. Furthermore, these flow exposed cells were stained for L-pSmad2, a signalling protein found to increase with shear stress in another cell type. Under confocal microscopy, it was determined that exposure to fluid shear stress influenced both β-catenin activity and L-pSmad2 protein expression in embryonic stem cells. Overall, this study provides a better understanding of the cell signalling responsible for controlling the pluripotency of embryonic stem cells.