
Preface

It is timely and exciting to compile some of the key molecular biological protocols and experimental strategies currently employed to study the various stages of mammary gland development. To this end we have invited leaders in the field to contribute detailed descriptions of their methodologies. We begin with a comprehensive overview of mouse mammary gland development drawing particular attention to comparative human biology and then present our selection of core methodologies in four parts.

Owing to the importance of transgenic and knock-out mouse models to the field, we begin Part I with two reviews of genetically modified mouse models that exhibit prenatal and pubertal mammary gland phenotypes. We discuss these phenotypes in the context of embryonic and postnatal gland development while emphasizing the study of the terminal end bud and the process of branching morphogenesis. We then present detailed descriptions of transplantation techniques, isolation and transcriptome analysis of the mammary terminal end bud during ductal morphogenesis, as well as transcriptome analysis of mammary fibroblasts isolated from sections taken at puberty. We finally describe how the post-lactational involuting gland can be used as a model to study epithelial cell death. In Part II we present a selection of 2D and 3D-model culture systems that have been employed to investigate a variety of mammary epithelial cell behaviors in vitro. We begin with a contractile assay for the study of myoepithelial cells and then present methods for in vitro recapitulation of mammary epithelial cell organization in the now infamous 3D acinus formation assay. In particular, we focus on the intrinsic molecular requirements for acini formation such as the role of MAP kinases and transient EMT, but also that of the microenvironment, examining the role of other cell types and how mechanical forces affect aggregated epithelial cells. Part III deals with stem cells and the mammary gland and we present methodologies for mammary stem cell isolation, reprogramming of progenitor populations, and a description of some strategies and methods for cell lineage tracing. Lastly, Part IV highlights some translational applications that provide a bridge between experimental studies of mammary gland development and the study of human breast cancer, with tissue microarrays for biomarker discovery and the increasingly popular practice of generating patient-derived xenographs for the study of cancer progression.

Our hope is that this volume will have a wide readership: researchers whose primary interest is in mammary gland development; developmental biologists interested in related internally branched epithelial organs, for instance the lung, kidney, and salivary gland; epithelial cell biologists and those with an interest in molecular mechanisms underlying breast cancer.

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