

PREFACE

Spermatogenesis is a tightly regulated cellular renovation and differentiation process. It consists of self-renewal and differentiation of spermatogonial stem cells (SSCs), spermatocytic meiosis and spermiogenesis; each of these processes is essential to the continuous, successful production of male gametes. During spermiogenesis, haploid spermatids undergo extensive cellular, molecular and morphological changes, including acrosome biogenesis, flagellum development, cytoplasmic reorganization and chromatin condensation. These changes ultimately result in mature spermatozoa with an acrosome-covered head and motile tail. In this book, Chapter One summarizes the progress that has been made in understanding the molecular mechanisms underlying acrosome biogenesis, and the authors discuss the potential directions of future investigations of this process. Chapter Two briefly addresses the basics of spermatogenesis and the synthesis of ncRNAs, and then the authors discuss the recent progress in understanding of the functions of miRNAs, endo-siRNAs, piRNAs and lncRNAs in the regulation of spermatogenesis. Chapter Three provides a review of the current literature on testicular immunoregulation and its underlying mechanisms, along with its effect on testicular functions.

Chapter 1 – The acrosome is a secretory vesicle that covers the anterior part of the sperm nucleus and is essential for sperm-egg fusion and male fertility. Functional impairments of acrosome biogenesis are associated with globozoospermia. Acrosome biogenesis is an important aspect of mammalian spermatogenesis, and it involves multiple cellular processes, such as vesicular trafficking, fusion, anchoring of the acrosome to the nucleus and morphogenesis of the acrosome. Although the process of biogenesis of the acrosome has been well documented, the detailed molecular mechanisms

remain unclear. Recently, several molecular components were found to contribute to acrosome biogenesis. In this review, the authors summarize the progress that has been made in understanding the molecular mechanisms underlying acrosome biogenesis, and the authors discuss the potential directions of future investigations of this process.

Chapter 2 – Spermatogenesis is a continuous and organized process that occurs throughout the adult life of a male, by which spermatogonia proceed through mitosis, meiosis and complex cytological transformations resulting in the formation of spermatozoa. This process requires precise and highly ordered regulation of gene expression at both the transcriptional and posttranscriptional levels. Recent advances in genome-wide analyses of the mammalian transcriptome have revealed that in addition to mRNAs, several types of noncoding RNAs (ncRNAs), including microRNAs (miRNAs), endogenous small-interfering RNAs (endo-siRNAs), PIWI-interacting RNAs (piRNAs) and long noncoding RNAs (lncRNAs), are extensively transcribed during testis development and spermatogenesis. These ncRNAs are expressed in a cell-specific and step-specific manner to participate in the control of germ cell differentiation during spermatogenesis. In this review, the authors first briefly address the basics of spermatogenesis and the synthesis of ncRNAs, and then they discuss the recent progress in understanding of the functions of miRNAs, endo-siRNAs, piRNAs and lncRNAs in the regulation of spermatogenesis.

Chapter 3 – The mammalian testis has a special immune microenvironment essential for spermatogenesis. The testis is a remarkable immunoprivileged tissue that protects male germ cells from detrimental immune responses. Various immune cells reside in the testis and are able to regulate spermatogenesis. Numerous immunoregulatory cytokines are produced by testicular cells, and they participate in the regulation of testicular immunoprivileged environment. To overcome the immunoprivileged status and enable effective local defense against microbial infections, most testicular cells adopt the innate immune functions. Therefore, a density of local immunoregulatory networks interplay in maintaining testicular immune homeostasis. Disruption of the testicular immune homeostasis may result in orchitis, leading to male infertility. In this article, a review of the current literature on testicular immunoregulation and its underlying mechanisms, along with its effect on testicular functions, is provided.