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Epididymal cell secretory activities and the role of proteins in boar sperm maturation

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Abstract

The final stages of sperm differentiation occur outside the gonad, in the epididymal tubule. These last maturation steps, essential to the quality of spermatozoa, are not under the genomic control of the germ cells. A series of sequential interactions with the epididymal fluid, mostly specific proteins present in the lumen of different regions, are believed to induce the final steps of sperm maturation. In order to provide the luminal changes required for this maturation to occur, the epithelium may resort to two basic mechanisms: absorption and secretion. Far from being a uniform channel, the epididymal duct is a canal with highly specialized regional differentiation of its epithelial ultrastructure and its secretory and absorptive functions. This review focuses on the ultractructural characteristic of the epithelial cells, their specific secretory activity according to the epididymal regions and their eventual role in sperm maturation of the boar. The chronology of the changes that occur in and on the sperm and in the surrounding environment are described. Relationships between the highly regionalized epididymal activities, sperm characteristics linked to their survival and fertility potential are also presented in this review.

Keywords: Epididymal fluid; Epididymal cell secretion; Secretory proteins; Reproduction; Boar sperm maturation

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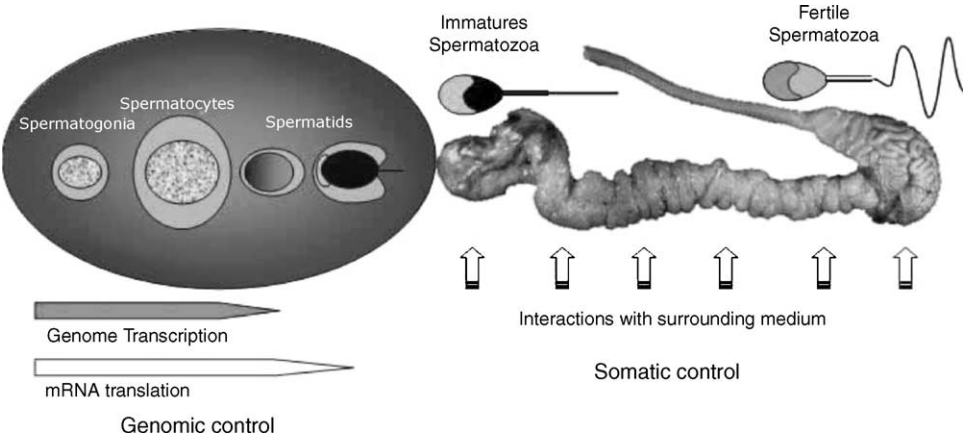

Fig. 1. Schematic representation of the process of formation and control of the male gamete through the testis and the epididymis.

1. Introduction

The formation of the male gamete is the result of extensive cellular differentiation that occurs during the transformation of a round spermatid into a highly polarized and fully motile cell. Most of these complex biochemical, physiological and morphological events of cellular differentiation take place in the testis during the process of spermiogenesis. During this testicular processing, cellular events are mostly under genomic regulation of the gamete. However, when DNA begins to condense in the elongated spermatids, the transcription process in the germinal DNA decreases and then stops. At the final testicular phase of male gamete differentiation, the spermatozoa that are neither motile nor fertile require additional discrete and essential post-gonadal modification to be able to fertilize eggs. Thus, the presence of a specific sperm environment during the subsequent differentiation stages in the epididymis is believed to play an essential role in controlling or inducing the final sperm changes.

The maturation stage of spermatozoa in the epididymis is out of the control of the germinal genome and is therefore largely the consequence of their interactions with the epididymal fluid, mostly with specific proteins present in the lumen of the epididymal tubule (Fig. 1). This specific microenvironment, which is isolated from the blood by the epididymal-blood barrier, also ensures protection of the gametes until ejaculation as well as regulation of the functionality and integrity of the epididymis.

Understanding of these post-testicular effects on the sperm and on the epididymal environment is essential to obtain good markers for fertility prediction for the animal and for sperm fertility and conservation.

2. Post-testicular environment of the spermatozoa

From the testis, the spermatozoa are transported into an epididymal tube that forms an organ composed of several regions, such as the caput, corpus and cauda (Fig. 2). The