ELSEVIER

Animal Reproduction Science 107 (2008) 237–248

ANIMAL REPRODUCTION SCIENCE

www.elsevier.com/locate/anireprosci

The roles of the epididymis and prostasomes in the attainment of fertilizing capacity by stallion sperm☆

E. Sostaric[a,*], M. Aalberts[a], B.M. Gadella[b,c], T.A.E. Stout[a,d]

[a] *Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, P.O. Box 80.156, NL-3508 TD Utrecht, The Netherlands*

[b] *Department of Biochemistry and Cell Biology, Faculty of Veterinary Medicine, Utrecht University, P.O. Box 80.176, NL-3508 TD Utrecht, The Netherlands*

[c] *Department of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 7, 3584 CL Utrecht, The Netherlands*

[d] *Department of Production Animal Studies, Faculty of Veterinary Science, University of Pretoria, South Africa*

Available online 29 April 2008

Abstract

The epididymis is a long, tightly coiled tube within the lumen of which sperm matures. Sperm maturation involves morphological and biochemical changes in the sperm plasma membrane in response to epididymal secretions and their various proteins. Some of these proteins become outer membrane components while others become integral membrane proteins; transfer of some proteins to the sperm plasma membrane may be mediated by epididymosomes. Nevertheless, the molecular pathways by which spermatozoa acquire fertilizing capacity during their transit through the epididymis remain ambiguous. In a recent study of stallion epididymal sperm, we found that sperm harvested from different parts of the epididymis (caput, corpus and cauda) had a varying, but generally poor, ability to undergo the acrosome reaction *in vitro*. At ejaculation, however, sperm mix with seminal plasma which contains various components, including the small membranous vesicles known as prostasomes, that may enable the sperm to undergo physiological activation. Seminal plasma components may have a 'washing' effect and help to remove 'de-capacitation' factors that coat the sperm during storage in the cauda epididymis; alternatively seminal plasma and prostasomes may contain factors that more directly promote sperm activation. This article reviews current information

☆ This paper is part of the Special issue entitled "Proceedings of the 5th International Symposium on Stallion Reproduction", Guest edited by Terttu Katila.

* Corresponding author. Tel.: +31 30 2539775; fax: +31 30 2531054.
E-mail address: e.sostaric@uu.nl (E. Sostaric).

0378-4320/$ – see front matter
doi:10.1016/j.anireprosci.2008.04.011

on the roles of epididymal and accessory gland fluids on the acquisition of fertilizing capacity by stallion sperm.

Keywords: Stallion; Epididymis; Ejaculation; Sperm capacitation

1. Introduction

During their passage from the testis to the site of fertilization in the oviduct, mammalian spermatozoa encounter a wide range of fluids of different origins and composition (e.g. testicular and epididymal fluids, seminal plasma and oviductal fluid). These fluids have a major influence on post-testicular development and induce a range of temporally controlled maturational changes that allow sperm to develop fertilizing capacity, and culminate in the induction of capacitation. As a result of these changes, spermatozoa are transformed from immotile cells incapable of fertilization to vigorously active cells capable of binding to and fusing with an oocyte.

In mammals, the epididymis has numerous inter-related functions including reabsorption of the fluid secreted by the seminiferous tubules, and the maturation and storage of sperm (Jones, 2004). Studies on the role of the epididymis in sperm maturation have focused on the secretory activity of the epithelial cells lining the duct, the composition of the luminal fluid and the influence of this fluid, or its components, on immature sperm.

The majority of proteins entering the epididymis from the rete testis are reabsorbed in the initial segment of the caput epididymis. As a result, most proteins found in epididymal fluid are secretory products of the epididymal epithelium (Gatti et al., 2004). During epididymal transit, spermatozoa acquire new proteins, some of which are coating proteins that can be removed by washing with isotonic or hypertonic solutions, while others are incorporated as integral membrane proteins; this latter group includes the glycosylphosphatidylinositol (GPI)-anchored proteins, the transfer of which to the sperm plasma membrane is thought to be mediated by epididymosomes.

Maturation of sperm during their transit through the epididymis can be evaluated by assessing the progress towards the expected endpoints, namely the acquisition of motility and the ability to recognise, bind to, and penetrate the zona pellucida and fuse with an oocyte. In most species, spermatozoa attain their full fertilizing potential in the proximal cauda epididymis (Dacheux and Paquignon, 1980). In horses, however, this does not seem to be the case. Although the first pregnancy reported following the use of frozen-thawed stallion sperm was achieved using epididymal sperm (Barker and Gandier, 1957), subsequent studies have suggested that the fertility of stallion epididymal spermatozoa is significantly less than that of ejaculated sperm (Morris et al., 2000); moreover, any deficiencies cannot be overcome by simply depositing the sperm hysteroscopically closer to the site of fertilization (Morris, 2004). This is disappointing because there is considerable current interest in preserving sperm from the cauda epididymis of stallions that either die suddenly or are electively castrated, with the intention of using the sperm subsequently for routine artificial insemination.

This review focuses on the major sequential modifications of sperm during their transit through the epididymis, and concentrates on the role of epididymal proteins in maturation and the acquisition of fertilizing capacity by stallion epididymal sperm.