

Sperm maturation in the domestic cat

Eva Axnér*

Department of Clinical Sciences, Division of Comparative Reproduction, Obstetrics and Udder Health, P.O. Box 7054, Center for Reproductive Biology, Swedish University of Agricultural Sciences (SLU), SE-750 07 Uppsala, Sweden

Abstract

The epididymis is essential for sperm development and maturation, and, subsequently, the ability of spermatozoa to penetrate and fertilize the female gamete. Functional differences in segments of the long tubule are reflected by histological differences among epididymal regions. The feline epididymis can be divided into six different regions according to their histological differences. A marked increase in sperm concentration occurs between regions 2 and 3, indicating resorption of fluid in region 2, a concept supported by the histological characteristics of the epithelium. At the transition between regions 4 and 5, located between the caput and corpus epididymides, histological characteristics change from being that of a maturation function to being typical of a storage function. Migration of the cytoplasmic droplet and induction of motility occur in this same region. Proteins are secreted from epithelial cells in the feline epididymis by merocrine and apocrine secretion, although the functions of different feline epididymal proteins have not been determined. Hypotaurine, taurine and, probably, alkaline phosphatase are produced by the feline epididymis. During epididymal transit the percentage of immature, unviable and morphologically abnormal spermatozoa decreases, indicating the existence of a mechanism that removes abnormal spermatozoa. In contrast, the percentage of spermatozoa with abnormal tails increases slightly during epididymal transit. Most of the distal droplets present on spermatozoa in the cauda epididymis are lost at or after ejaculation. Additional knowledge of the feline epididymis should be beneficial for developing sperm preservation protocols and advance the prospects for effective male contraceptive methods.

© 2006 Elsevier Inc. All rights reserved.

Keywords: Feline; Epididymis; Sperm maturation; Caput; Corpus; Tail

1. Introduction

The epididymis is a dynamic organ in which substantial maturational changes of spermatozoa occur. The absorptive and secretory functions of epididymal epithelial cells affect the luminal environment and cell membrane of the maturing spermatozoa. During epididymal transit, spermatozoa acquire the capability to be motile. Also, the cytoplasmic droplet migrates from a proximal to a distal position, the composition of the plasma membrane changes and sperm fertilizing ability develops. In the cauda epididymis, the specific

luminal environment allows spermatozoa to survive for several weeks. Maturational changes of spermatozoa during epididymal transit have been studied in several species, but few studies have been performed in felids.

2. Sperm transit through the duct

In the cat, daily sperm production per testis has been estimated to be 16 million [1]. The duration of spermatogenesis is constant within a species. In the cat, after this 47-day interval [1], all spermatozoa from the same generation are simultaneously released into the epididymis [2,3]. Although the length of the epididymal duct varies among species [4], the mean duration of epididymal transit is similar in most species. To the

* Tel.: +46 18 67 21 81; fax: +46 18 67 35 45.

E-mail address: Eva.Axner@kv.slu.se.

author's knowledge, the transit time has not been estimated in the cat, but is usually 10–12 days in other species [2,3]. Epididymal transit is more rapid in the periphery of the duct, and spermatozoa of different ages are found in the caudal region [2]. Frequent ejaculations do not result in release of immature spermatozoa since the rate of passage is increased only in the caudal portion, but not in the more proximal parts of the duct [3,5].

3. The epididymal duct

The epididymis is connected with the rete testis by multiple efferent ducts [6]. It is a single long and highly convoluted duct [4]. Spermatozoa are transported from the caput to the cauda by peristaltic activity of smooth muscular cells surrounding the duct [3]. Anatomically, the epididymis can be grossly subdivided into the caput, corpus and cauda regions, divisions which do not necessarily relate to function. Glover and Nicander [7] subdivided the epididymal duct into the initial (first introduced by Benoit) [8], middle and terminal segments, based on function rather than location. The function of the initial and middle segments was regarded to be sperm maturation and the function of the terminal segment was considered to be sperm storage before ejaculation [7]. As these segments are based on function, histology and ultrastructure of the epididymal epithelium, the localization of the initial, middle, and terminal segments does not necessarily correspond to the macroscopic division into the caput, corpus and cauda epididymis, in all species. In the cat, both the initial and the middle segments are located in the caput epididymis [9].

4. Regional histology of the epididymal duct

The epididymal duct is lined with a pseudostratified epithelium. The main cell type is the “principal cell”, which is covered with stereocilia. Principal cells are characterized by structures associated with absorption, such as microvilli, vesicles and lysosomes [10] and by structures characteristic of protein secretion, including rough endoplasmic reticulum and a large Golgi complex [10,11]. Apart from the principal cells, there are basal cells and apical cells in the epithelium of the feline epididymal duct [9,10]. Sánchez et al. [12] have also described periodic acid Schiff (PAS)-positive, narrow cells in the feline epididymis. The epithelial lining of the duct has regional structural differences, which are likely to be related to functional differences [9,13].

Different species have different numbers of regions. There are eight in the rabbit [13], six in the stallion, ram, bull [14], rat [15] and boar [16] and seven in the guinea

pig [17]. As previously mentioned, the feline epididymal duct can be divided ultrastructurally into the initial, middle or intermediate and terminal segments, according to the definition by Glover and Nicander [7,18]. In the initial segment, the principal cells have moderate pinocytotic activity, few vacuoles and a conspicuous Golgi apparatus. Principal cells of the middle segment have pronounced pinocytotic activity and an extensive Golgi apparatus. In the terminal segment, there are few signs of pinocytosis and the Golgi apparatus seems to be inactive [18]. These ultrastructural regions can be further subdivided into six different regions, according to morphometric and histological characteristics [9]. Regions 1–4 are localized within the caput, region 5 in the corpus, and region 6 in the cauda of the feline epididymis (Fig. 1).

4.1. Region 1

Region 1 of the feline epididymis shows the characteristics of the initial segment as described by Glover and Nicander [7,9]. The principal cells are long,

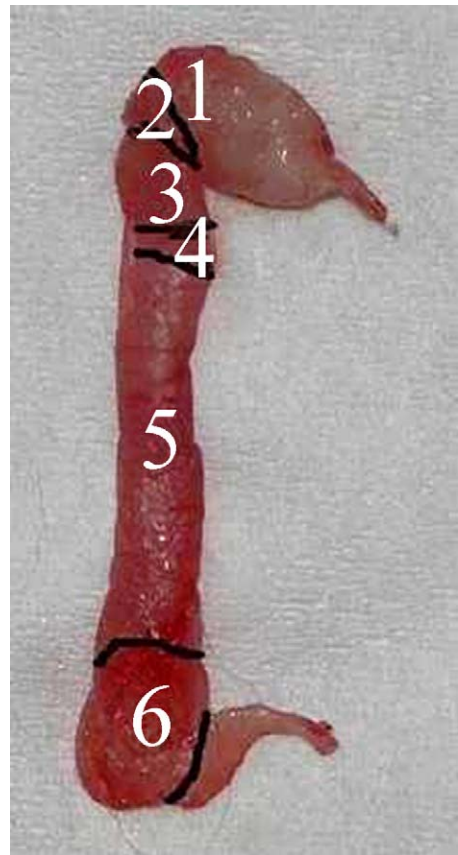


Fig. 1. Localization of the epididymal regions in the cat.

Download English Version:

<https://daneshyari.com/en/article/2097141>

Download Persian Version:

<https://daneshyari.com/article/2097141>

[Daneshyari.com](https://daneshyari.com)