ON THE ULTRASTRUCTURE AND DEVELOPMENT OF THE PROTOPLASMIC DROPLET OF SPERMATOZOA*

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With 9 Figures in the Text

(Received August 15th, 1961)

In spite of the fact that the protoplasmic droplet of the mammalian spermatozoon was described already by RETZIUS (1909) the nature of this structure is still rather obscure. WEIGL (1912), GATENBY and WOODGER (1921), BELL (1929), GATENBY and COLLERY (1943), and GRESSON and ZLOTNIK (1945, 1948) suggested that the droplet contained elements derived from the Golgi apparatus of the spermatid. CAVAZOS and MELAMFY (1954) have recently given some support to this theory. REDENZ (1924) and many later authors have noted that the droplet changes position from the neck region to the posterior part of the middle piece of the spermatozoa during the passage of the latter through the epididymis. This movement of the droplet is, in fact, the only morphological change known to occur in the spermatozoa during this passage.

Little is known of the actual function of the droplet. Its role has most often been assumed to be nutritive. The well known fact that the spermatozoa do not attain full functional maturity until they have reached the cauda epididymidis indicates a correlation between the wandering protoplasmic droplet and the sperm-maturation process. Sperms in which the droplet has remained in the anterior position show a poor fertility and ejaculates, containing a high percentage of such spermatozoa are considered to indicate a spermatogenetic disturbancy (LAGERLÖF 1934, and others).

Although the structure and formation of the mammalian spermatozoon has been the object of many electron microscopical studies very little interest has been devoted to the protoplasmic droplet and a report on its ultrastructure is lacking in the literature. In order to shed some light on the question of the nature of this structure it was considered of interest to investigate, with the aid of the electron microscope, the fine structure of the protoplasmic droplet of spermatozoa from various animal species and from different levels of the epididymis as well as details of its development during spermateliosis.

Material and Methods

Epididymal spermatozoa from bull, ram, rabbit, and rat were studied. Those from bull and ram were taken from regions 3 and 6 of the ductus epididymidis (NICANDER 1958), i.e. just before the movement of the droplet down the middle piece, and at the most posterior part of the epididymis, respectively. An incision was made in the wall of the duct and drops of the luminar contents were placed on small paper strips, which were then floated onto the

* Financial support for this study was received from the Swedish Medical Research Council and the Wallenberg Foundation.
surface of a buffered osmiumtetroxide solution (Palade 1952) in a small, closed vessel. Fixation time was generally one hour. The thin films of fixed epididymal contents were removed and broken into smaller pieces during the subsequent washing and embedding procedure. Epididymal spermatozoa from rabbit and rat were studied in situ in small pieces of the epididymis fixed in Palade's fluid with the addition of sucrose (Caufield 1959) for 1—2 hours. Small pieces of testicular tissue from bull, ram and rabbit were also fixed in Palade's fluid. Embedding was performed in butyl methacrylate with the addition of 5 per cent methyl methacrylate, except for the epididymal material from rabbit and rat, which was embedded in epoxy resin (Epon) according to Luft (1961). Specimens were sectioned on a Porter Blum-microtome or a LKB Ultrotome and the sections were examined in a Siemens Elmiskop I at 80 kV, or an RCA type EMU 2b electron microscope. Electron optical magnifications varied from 2300 to 19000 diameters.

**Observations**

**a) The droplet in epididymal spermatozoa**

No important differences regarding droplet fine structure were noted in sperms from bull or ram, and the following description includes spermatozoa from both species.

![Image](image-url)

**Fig. 1.** Oblique section through protoplasmic droplet and base of sperm head (H). C centriolar structures. Caput epididymidis, bull. 35 000 ×

The protoplasmic droplet of spermatozoa from region 3 of the duct surrounds the neck region of the spermatozoon, from the base of the head to the anterior part of the mitochondrial sheath. The droplet is limited by the cell membrane covering the whole spermatozoon. Its interior is crowded with small vesicles and fine, often curved tubules or lamellae, apparently oriented at random. Some