CYTOPLASMIC BODIES CONTAINING MITOCHONDRIA, RIBOSOMES, AND ROUGH SURFACED ENDOPLASMIC MEMBRANES IN THE EPITHELIUM OF THE SMALL INTESTINE OF NEWBORN RATS

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During recent years cytoplasmic corpuscles commonly known as dense bodies, lysosomes, multivesicular bodies, cytosomes, phagosomes, and microbodies have attracted much attention (see reviews by de Duve (3) and Novikoff (5)). Probably the different terms cover the same concept in several cases, but it is not clear what the exact relationship between these various corpuscles is, and whether they bear a possible relationship to other cell components.

During a study of the epithelium of the small intestine in newborn rats we found in several instances cytoplasmic bodies containing mitochondria, vesicles, ribosomes, and rough surfaced endoplasmic reticulum. Mitochondria and what looks like mitochondrial residue have been observed earlier in cytoplasmic bodies in the epithelium of the small intestine of adult mice (11). In the proximal tubule cells of the kidney of infant mice, Clark (2) found membrane-bounded cytoplasmic bodies and vacuoles which sometimes contained lamellar inclusions and altered mitochondria. Similar cytoplasmic vacuoles containing mitochondria in apparently varying states of disintegration have been observed by Novikoff (4) in the proximal tubule cells in experimentally produced hydronephrosis. As far as we know, bodies with incorporated rough surfaced endoplasmic reticulum have not been reported.

MATERIAL AND METHOD

The upper portion of the small intestine of newborn rats was used for this investigation. The animals were withdrawn from their mother immediately after birth and were examined nonfed. The tissue was removed under light ether anesthesia and fixed in cold, buffered osmium tetroxide (Palade (6)) following the procedure given by Sjöstrand (9). Embedding was done in Vestopal (8). Sections were stained with 4 per cent uranyl acetate solution (10) for 1 or 2 hours and studied in a Philips electron microscope, type EM 100 B.

OBSERVATIONS AND COMMENTS

Fig. 1 shows a cytoplasmic body from the basal part of an epithelial cell from a crypt anlage. In the lower part of the body a mitochondrion is seen containing three osmiophilic bodies. Above this is an area with free ribosomes and two ribosome-covered membranes separated by a space, as in endoplasmic reticulum. The upper part of the body consists mainly of wrinkled membranes in a rather dense substance. Fig. 2 shows another section through the same body. The rough surfaced membranes can here be followed for a longer distance.

With the possible exception of the upper part, the cytoplasmic body is limited by a membrane

FIGURE 1

Electron micrograph of the basal portion of an epithelial cell from a crypt anlage of a newborn rat. In the center is a cytoplasmic body containing a mitochondrion, ribosomes, rough surfaced endoplasmic reticulum, and, at the top, wrinkled membranes. The body is limited by a membrane system. At the upper right corner, part of the nucleus is seen; at the lower left, the infolded plasma membrane is visible. × 33,000.

system that seems to be formed by unit membranes (Robertson (7)) similar to the plasma membrane. Below the mitochondrion the membrane seems to be single. To the right and to the left it splits into two membranes separated by a space. On the right side these two membranes continue on each side of the upper dense part of the body. On the left they unite closing the interposed space. Before that point, however, two other membranes are split off. These membranes continue on each side of the upper part of the body.

Thus the outer membrane system of the body is rather complicated, and it is not easy to imagine how it originated. One of several possible mechanisms might be the fusion of vesicles formed by invagination of the plasma membrane. Figs. 3 and 4 show two sections through a cytoplasmic body from another cryptal epithelial cell. Unit membranes forming vesicles and flat sacs surround this body. If these vesicles and sacs should fuse, and their spaces become partly obliterated, a membrane system similar to that seen in Fig. 1 might be formed. A continued growth of the body might take place by apposition of new layers of vesicles.

Cytoplasmic bodies of the type described are observed in the epithelium of the small intestine in rat fetuses from the 16th day of gestation (Behnke (1)). It might be that they are a manifestation of intracellular isolation of cell components and represent initial stages of the lysosomes, which, according to de Duve (3) and Novikoff (5), are thought to play a role in physiological intracellular autolysis.

The electron microphotography was performed in the Laboratory for Electron Microscopy, the Municipal Hospital of Copenhagen. The authors are greatly indebted to Dr. Torben Fog and Dr. Vagn Dahl for hospitality. This work has been supported by grants to Dr. Harald Moe from King Christian the Tenth's Foundation and from the Danish State Research Foundation.

Received for publication, November 17, 1961.

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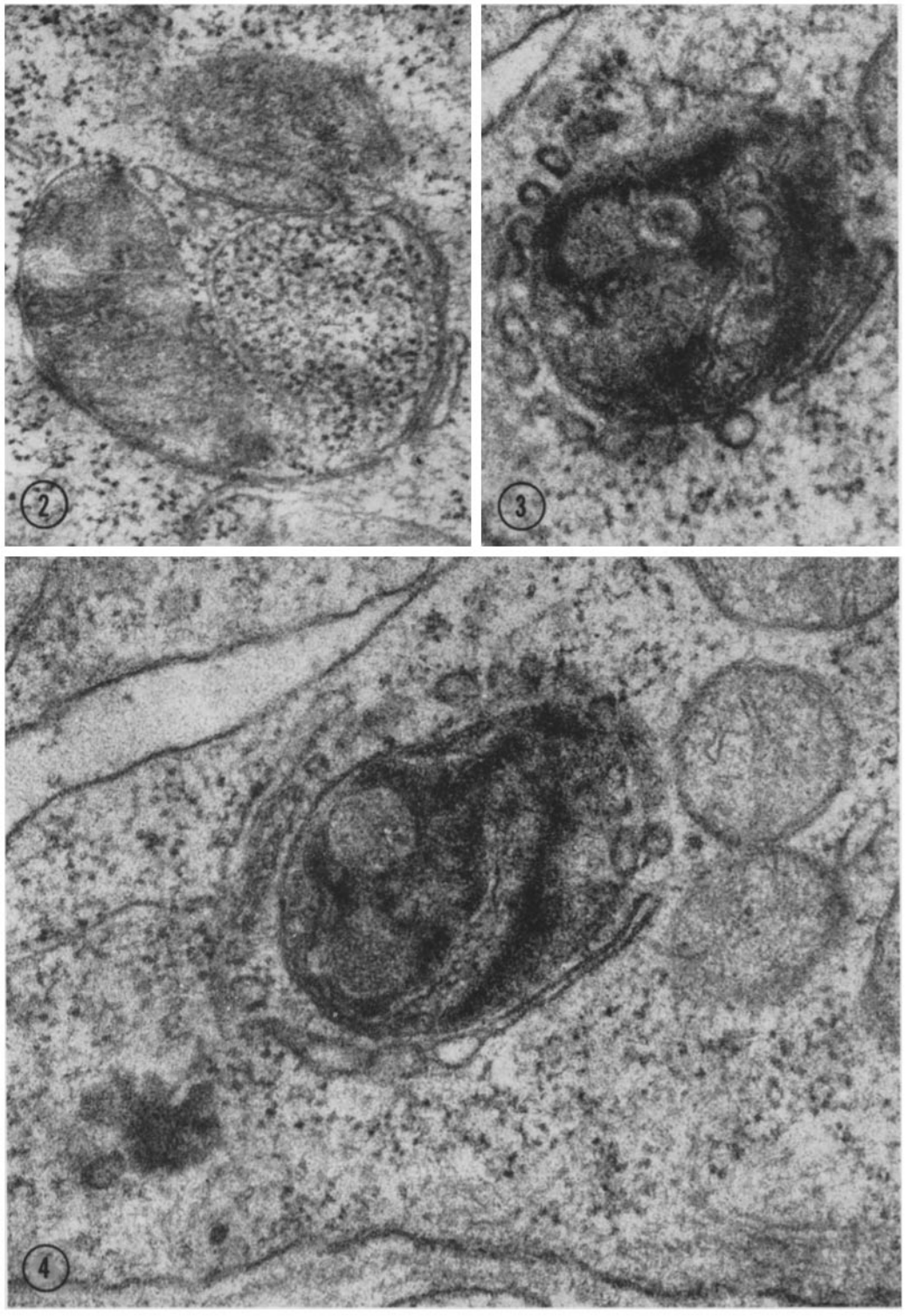
FIGURE 2

The same cytoplasmic body (as in Fig. 1) cut at another level. The rough surfaced membranes can here be followed for a longer distance. The membranes seem to continue into the upper dense part of the body. × 68,000.

FIGURES 3 AND 4

Two sections through a similar cytoplasmic body from the basal part of another cryptal cell. The body is surrounded by a layer of round vesicles and flat sacs bounded by unit membranes. At the bottom of Fig. 4, the plasma membrane and the basement membrane are seen. × 88,000.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