

INTRANUCLEAR RODS IN PANCREATIC ISLET β -CELLS

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In the course of ultrastructural studies on the morphology of the pancreatic islets of various rodent species used in current diabetes research, intranuclear rod-shaped structures were observed in the β -cells of mice. Since there appeared to be no previous reports on the occurrence of such structures in endocrine pancreas of any species, it was thought worth while to pay some further attention to them.

MATERIALS AND METHODS

The animals were eight obese-hyperglycemic mice and 22 of their lean litter mates. They were originally obtained from the Jackson Laboratories, Bar Harbor, Maine, and subsequently bred at the Department of Histology and the Institute of Pathology, University of Umeå, Sweden. The mice were 4–16 mo old and of both sexes. They were kept on a standard laboratory diet and drinking water *ad lib*.

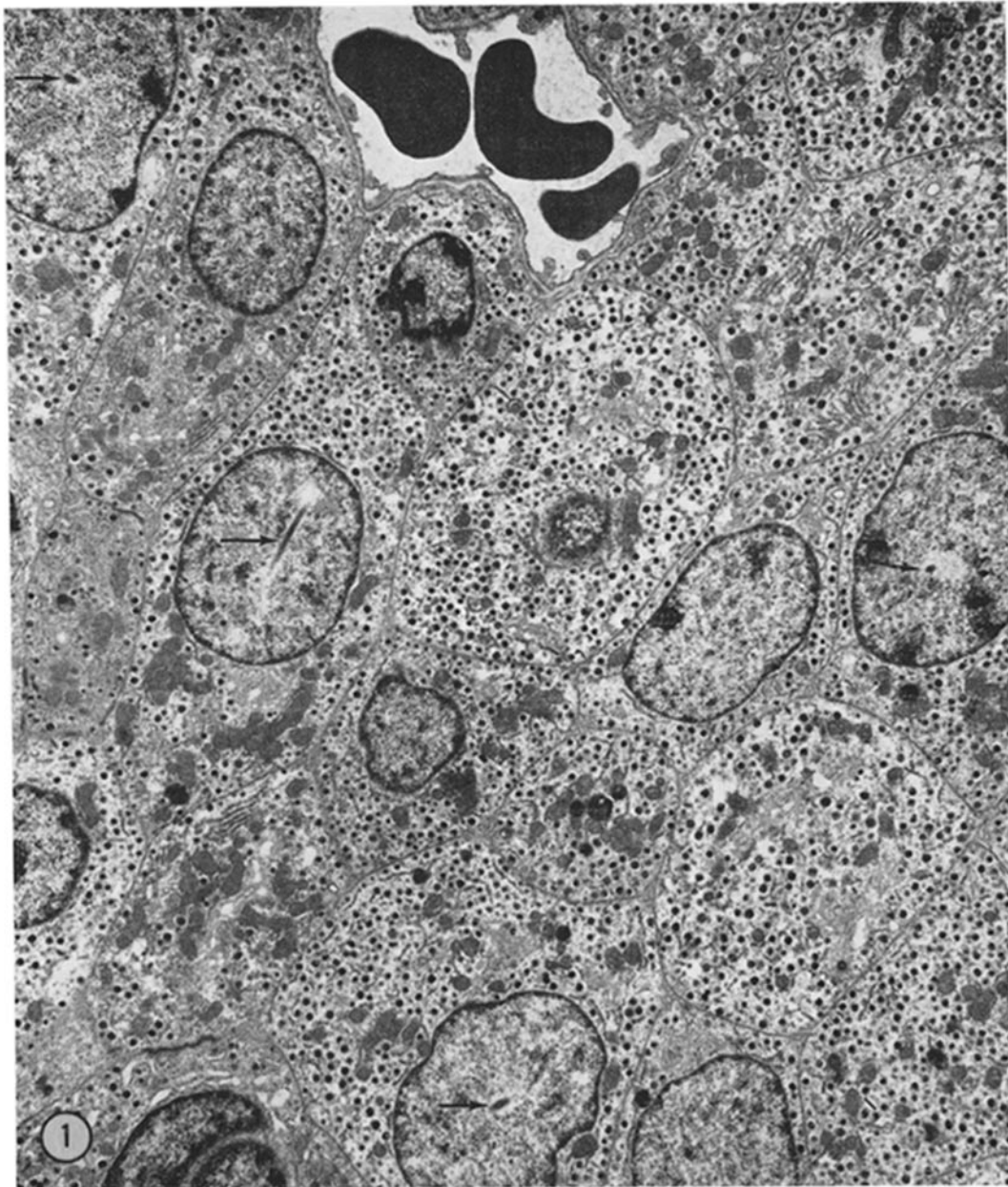


FIGURE 1 Survey of a pancreatic islet demonstrating β -cells from obese-hyperglycemic mice with numerous secretory granules in their cytoplasm. In the central part of the nuclei of four of the β -cells there are shorter or longer rod-shaped structures (arrows). The nucleoplasm surrounding the rods often shows low electron opacity. $\times 6,000$.

The following ultrastructural procedures were used. The animals were sacrificed, and specimens were immediately taken from the pancreas and fixed by immersion in 1% osmium tetroxide in 0.34 M

Veronal acetate buffer adjusted to pH 7.2-7.4. After fixation the specimens were rinsed, dehydrated with ethanol, and embedded in Epon 812. For trimming the blocks and for identification of the islets,

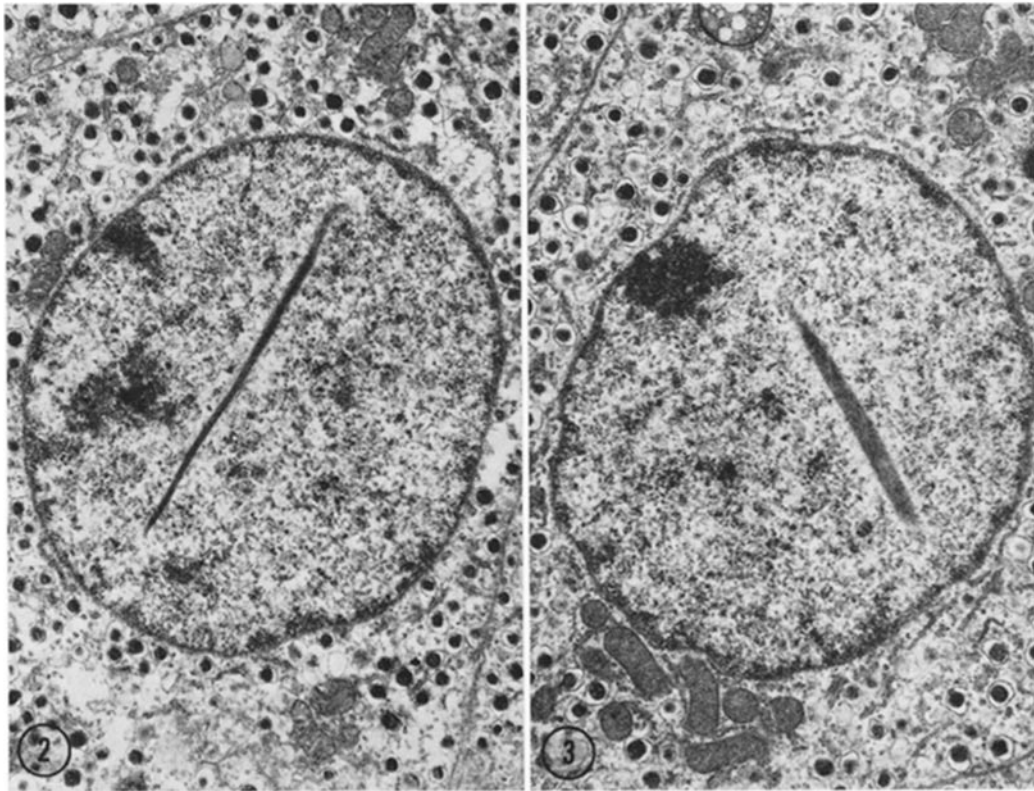


FIGURE 2 Pancreatic islet β -cell, from an obese-hyperglycemic mouse, with typical cytoplasmic secretion granules and an oval nucleus containing a slender, moderately electron-opaque, rod-shaped structure without connection with the nucleolar elements or the cell membranes. $\times 12,600$.

FIGURE 3 Pancreatic islet β -cell from one of the lean litter mates, showing a more coarse, moderately electron-opaque intranuclear rod without connection with nucleolus or cell membranes. $\times 12,600$.

adjacent thick ($1\ \mu$) sections were stained with toluidine blue and examined under a light microscope. The sections were cut on an LKB Ultratome III and stained with uranyl acetate and lead citrate prior to examination in a Siemens Elmiskop I A and/or 101. From each mouse, one to four islets of somewhat varying size and one section from every islet were investigated for the occurrence of intranuclear rods in the islet parenchymal cells.

RESULTS

In the central part of the nuclei of some of the β -cells moderately electron-opaque rods were found (Fig. 1). The nucleoplasm surrounding the rods often showed less electron opacity than that in other parts of the nucleus. The rods could be either slender (Fig. 2) or more coarse (Fig. 3) and were often tapered at the ends. There were no

connections between the rods and the nucleoli or nuclear membranes. The rods were composed of closely packed, roughly parallel fibrillar or tubular elements (Figs. 4 and 5). They were straight or slightly curved (Fig. 6). Close to the ends of the rods rounded structures were infrequently recorded (Fig. 7). These structures exhibited similar electron opacity as the rods. It was not possible to make clear whether these structures were associated with the rods. Though most of the nuclei containing rods were rounded or oval, there were also those showing slight or moderate irregularities. Bi- or tripartite rods were not seen. There were no signs of degeneration in cells containing rods. In the presently investigated mice, intranuclear rods were not observed in the α_1 -, α_2 -, or agranular cells.

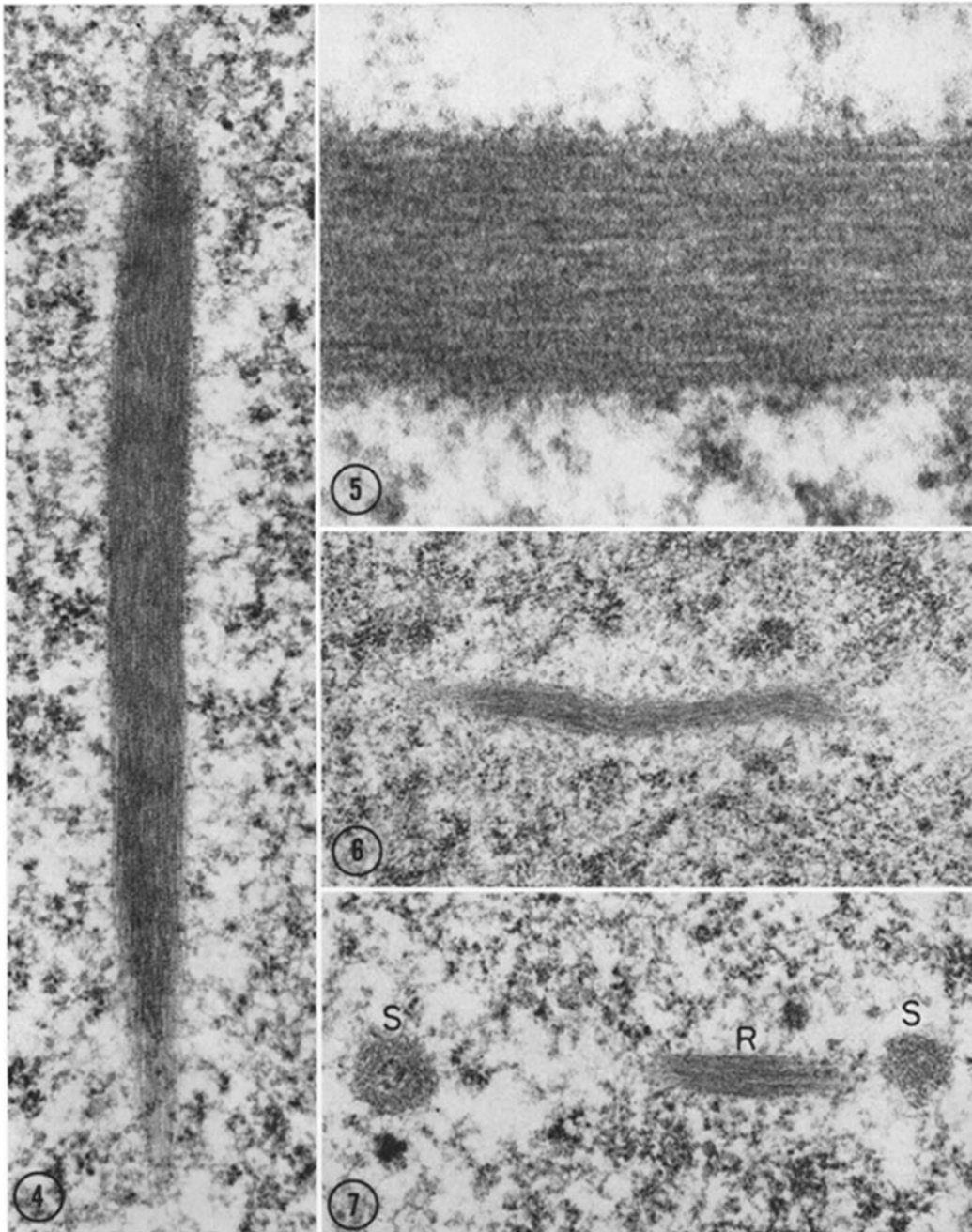


FIGURE 4 Portion of a β -cell from a lean litter mate, showing a nucleus with a rod that seems to be composed of fibrillar elements. The rod is somewhat tapered at the ends. The nucleoplasm surrounding the rod exhibits rather low electron opacity (same cell as in Fig. 3). $\times 44,000$.

FIGURE 5 Higher magnification of an intranuclear rod in a pancreatic islet β -cell from a lean litter mate, showing a roughly parallel arrangement of closely packed structures that appear to be of fibrillar nature (same cell as in Fig. 3). $\times 90,000$.

FIGURE 6 Portion of pancreatic islet β -cell from an obese-hyperglycemic mouse, showing a nucleus containing a slightly curved rod-shaped structure. $\times 33,000$.

FIGURE 7 Portion of a nucleus in a pancreatic islet β -cell from a lean litter mate, demonstrating a moderately electron-opaque rod (R). Close to but without obvious connection with the rod there are two moderately electron-opaque structures (S). The diameters of these structures seem to be greater than the thickness of the rod. $\times 44,000$.

In the islet sections intranuclear rods were found in the β -cells of 14 of the 22 lean mice and in six of the eight obese-hyperglycemic mice investigated. One to seven (on an average, 4) cells with rods could be found in one islet from both the lean and obese-hyperglycemic mice. No obvious sex or age differences were recorded.

DISCUSSION

The endocrine pancreas in obese-hyperglycemic mice and their lean litter mates has previously been studied by both light (4, 12) and electron (1) microscopy. Reports on the occurrence of intranuclear rod-shaped structures in these animals appear, however, to be lacking. Similar structures have not been recorded in the pancreatic islets of other rodents used in diabetes research, e.g. the Chinese hamster (2). In nerve cells of some mammalian species, on the other hand, intranuclear rods or tubules have been observed by electron microscopy (7, 9-11). It has been stated that these intranuclear structures correspond to those found by light microscopy in various kinds of nerve cells by older anatomists and that they are limited to certain nerve cells and to certain species (9). It seems that the intranuclear rods found in the present study are similar to and probably morphologically identical with those occurring in nerve cells. Such rods in nerve cells have been suggested to be involved in amitotic cell division (11) or to have unknown significance (9). Intranuclear fibrillar bodies, which are somewhat similar to the presently investigated intranuclear rods in mice, have been seen in actinomycin D-treated oocytes of the newt and have been suggested to possibly represent protein material (8). It could not be demonstrated in the present study whether the intranuclear rods found in the β -cells of mice have any functional significance. Since it is known that at least the obese-hyperglycemic mice exhibit marked islet hyperplasia (3, 6, 12), a large number of islet β -cells (3), as well as cytological signs of β -cell hyperactivity (5), it can, however, be speculated that the intranuclear rods play some role in cellular activity, or in cell renewal and division. Since signs of degeneration were not recorded in cells containing intranuclear rods, the possibility that these structures are of degenerative nature seems less probable.

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