

Position determined dense bodies in granules of monkey (*Cercopithecus ethiops*) parotid gland

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The parotid gland of monkey (*Cercopithecus ethiops*) was examined by electron microscopy. Secretory granules show a bipartite, or sometimes a tripartite structure consisting of a main portion and of one or two dense bodies contained in it. Discharge of secretion into the lumen seems to take place following the fusion of the membrane of the secretory granule with the plasmalemma. This seems to take place with the dense bodies in intimate contact with the fusion-area of the granule membrane.

Key-words: Ultrastructure; secretory granules

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It is well known that salivary glands show numerous species variations in their histochemistry and fine structure (16, 17). Secretory granules are regarded the most distinctive feature of acinar secretory cells of primate salivary glands. Their number depends on the secretory activity (or phase of secretory cycle) of any particular cell. In many species the granules occupy most of the cell, apparently compressing the cytoplasmic organelles and even the nucleus. At the ultrastructural level many of the diversities described have been concerned with a variety of substructures noted within the secretory granules (17, 12, 14). The widest range of variation has been noted in the submandibular gland. Studies by Riva & Riva-Testa (13) and Messelt (6) have shown

that parotid glands of both humans and monkeys also exhibit granules which, in most cases, contain a substructure in the form of a dense spherulite. In the present report interest has been focused on the appearance and localization of these dense bodies in the granules of monkey parotid glands, and especially those close to the luminal membrane of acini cells and about to be shed.

MATERIALS AND METHODS

The observation recorded was taken from a study of the parotid gland of three monkeys. The animals were fixed under nembutal anesthesia by vascular perfusion through the carotid artery with dextran (Macrodex) followed by

1.7% glutaraldehyde in 0.1 M phosphate buffer at pH 7.3. The tissues were fixed for an additional period of 24 h by immersion in the perfusion fixative. The specimen were cut into small blocks before they were rinsed for 10 min in 0.15 M phosphate buffer at pH 7.3 and postfixed in 1% osmium tetroxide at 4°C for 2 h (9). After fixation the blocks were rapidly dehydrated in graded series of acetone solutions and embedded in Vestopal W (15). Ultrathin sections were cut on an LKB Ultratome III. The sections were treated with uranyl acetate for 30 min, followed by lead citrate (10) for 5 min. The sections were examined in a Siemens Elmiskop Ia electron microscope. For orientation, sections 1 µm thick were cut for light microscopy. These sections were stained with the Ponceau de Xylidine/Giemsa method (7).

RESULTS

Acini of monkey parotid gland consisted of pyramidal secretory cells. The cells varied in height from 15–20 µm and the basal width was normally small compared to the vertical axis. The cells were arranged around a central lumen which was commonly irregular in outline, and which was continuous with short intercellular canaliculi (Fig. 1). The amount of rough endoplasmic reticulum present in each cell was moderate and mostly confined to the basal region (Fig. 1). The secretory product was in the form of secretion granules (Figs. 1, 2). The granules, which had a diameter of 1–3 µm, were bound by a limiting membrane. They were usually densely packed and quite often they occupied the lion's share of the cell cytoplasm (Fig. 1). By serial sectioning it was found that at least 75% of the gra-

nules (judged by a count of 300) showed a bipartite structure, consisting of a main portion and of one, or more seldom two, dense bodies contained in it (Figs. 1, 2). The dense bodies were rounded and small, with a diameter of 0.5–0.7 µm. The dense bodies were often found at the periphery of the granules. The excentric position was especially noted when granules were close to the luminal membrane or just about to be shed (Figs. 1, 2). They seemed to be the first part of the granule content to achieve access to the luminal membrane of the acinus cell. By serial sectioning it was observed that at least 80% of the dense bodies behaved this way. Direct extrusion of secretory material into the lumen was seldom seen, but images of emptied granules were observed. Dense bodies were often encountered in the lumen (Fig. 3).

DISCUSSION

Based on staining reactions, as well as their ultra-structure, the acini of monkey parotid gland are found to consist of serous cells. Rather than being of a homogenous composition, the secretory granules of the parotid gland reveal a bipartite structure. It has become apparent in the last few years that secretory granules with obvious substructures occur with far greater frequency than granules with a uniform matrix. Dense bodies, like those observed in this study, have also been noticed in secretory products of Brunner's glands (11) and of the so called serous cells of bronchial submucosal glands (8). In salivary glands of other mammals they have been described, to the author's knowledge, in parotid (1) and submandibular glands (2) of squirrel monkey, in submandibular gland of rat, male hamster, rabbit and cat (3), mouse sub-

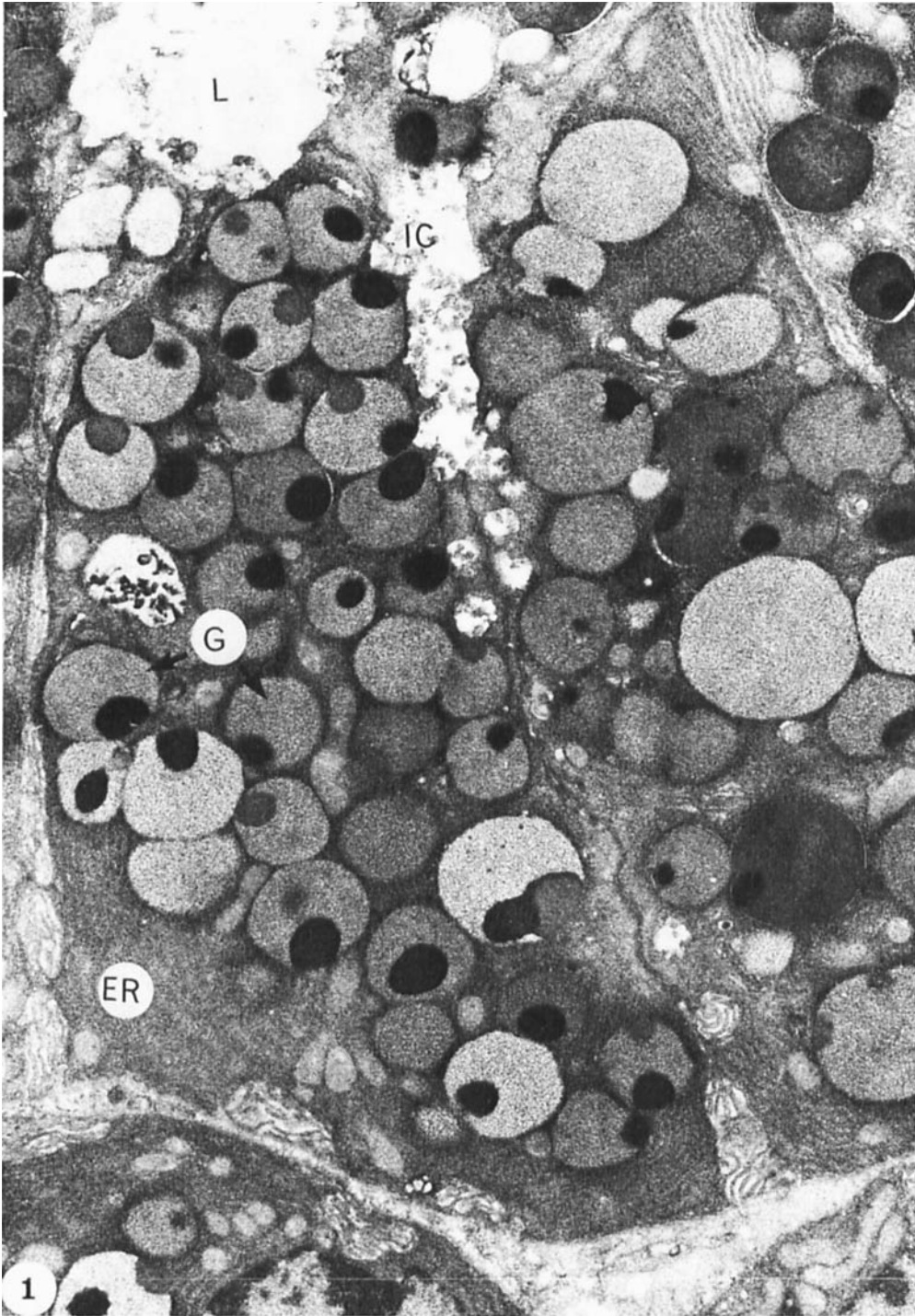


Fig. 1. Part of monkey parotid acinus showing cells which are heavily loaded with granules. L, lumen; IC, intercellular canaliculi; G, granules; ER, endoplasmic reticulum. X 13 500.

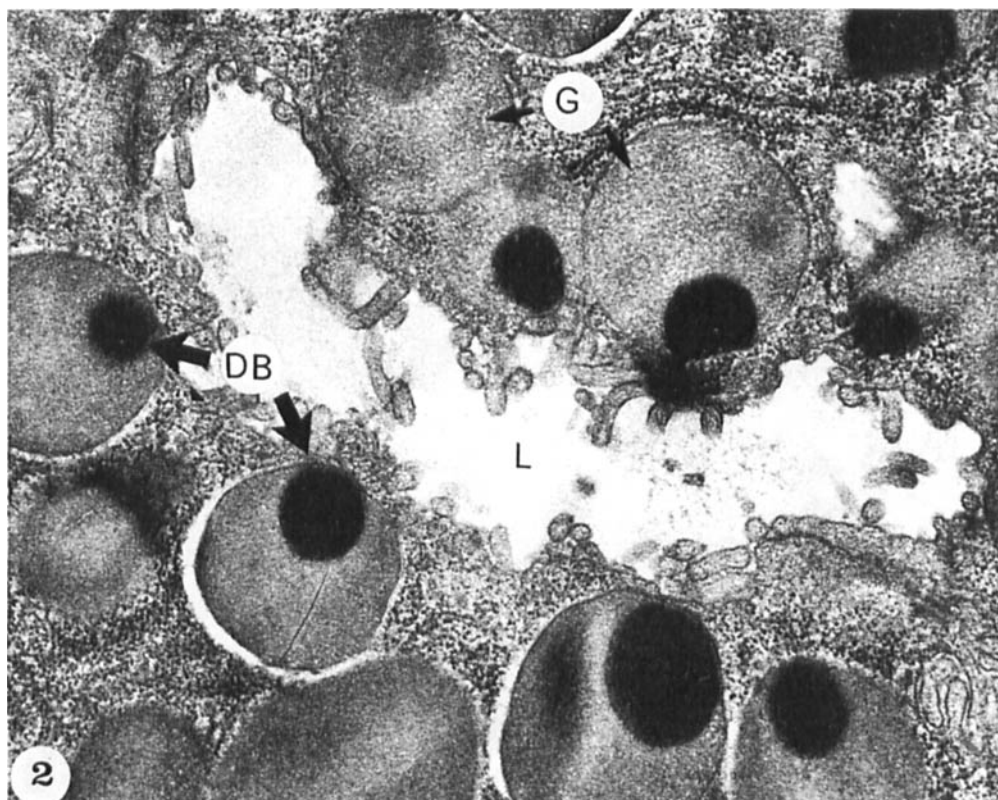


Fig. 2: Granules near the acinus lumen with eccentrically positioned dense bodies. L, lumen; G, granules; DB, dense bodies. X 21 000.

lingual gland (5), pig parotid (4) and human parotid (13) glands.

The significance of matrix zonation in the granules is not understood. The question has been posed whether or not this sequestration of components is a reflection of the presence of discrete aggregates of different enzymes within individual granules (18). The answer to this question can only be given after granules with a well-defined substructure are successfully isolated and analysed.

However, in the present study it seems that the dense bodies perform an excentrical change of position within the granule, making them the first part of the granules to come in contact with the apical cell membrane. This might suggest that the dense bodies take part

in the fusion of the granule membrane with the cell membrane, or the opening up of this membrane system, and are therefore of importance to the merocrine function of the cell. A function like this would most probably be mediated through enzymes.

At present, the only conclusion which can be drawn is that dense bodies may represent a distinct secretory component, whose nature is uncertain. Beside their density, the presence of discrete dense bodies inside the acinar lumina (Fig. 3) substantiates this assertion. This observation may imply that they dissolve in the lumen at a slower rate than the bulk of the secretory granule and are consequently of a different biochemical composition.

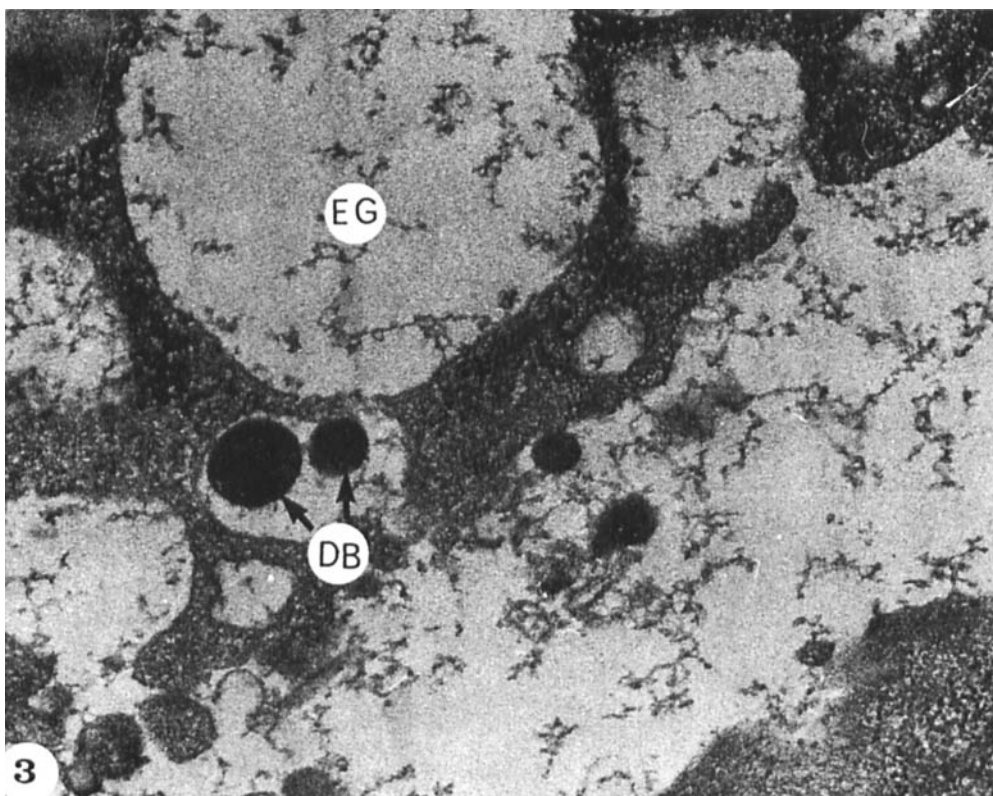


Fig. 3. Lumen of acinus with images of emptied granules. DB, dense bodies; EG, emptied granules. X 60 000.

REFERENCES

1. Cowley, L.H. & Shackleford, J.M. Electron microscopy of squirrel monkey parotid gland. *Ala. J. Med. Sci.* 1970, 7, 273 - 282
2. Cowley, L.H. & Shackleford, J.M. An ultrastructural study of the submandibular gland of the squirrel monkey, *saimiri sciureus*. *J. Morph.* 1970, 132, 117 - 136
3. Dorey, D. & Bhoola, K.D. Ultrastructure of acinar cell granules in mammalian submaxillary glands. *Z. Zellforsch.* 1972, 126, 320 - 334
4. Ferrandi, B. Prime osservazioni sulla fine struttura della parotide di maiale. *Clin. Vet.* 1969, 92, 407 - 417
5. Laj, M., Borghese, E. & Di Caterino, B. Acinar ultrastructure of sublingual gland of mus musculus during embryonic development. *J. Submicr. Cytol.* 1971, 3, 139 - 151
6. Messelt, E.B. On the fine structure of dense bodies in monkey (*Cercopithecus ethiops*) parotid gland. *J. Ultrastruct. Res.* 1979, 69, 144 - 145
7. Messelt, E.B. A new differential staining method of semithin sections of polyester-embedded salivary glands. *Acta Odontol. Scand.* In press.
8. Meyrick, B. & Reid, L. Ultrastructure of cells in the human bronchial submucosal glands. *J. Anat.* 1970, 107, 281 - 299
9. Millonig, G. The advantages of a phosphate buffer OsO_4 solution in fixation. *J. appl. Physiol.* 1961, 32, 1637
10. Reynolds, E.S. The use of lead citrate at high pH as an electron-opaque stain in electron microscopy. *J. Cell Biol.* 1963, 17, 208 - 212
11. Riva, A. & Zaccheo, D. Ricerche sulla ultrastruttura delle ghiandole duodenali dell'uomo. *Sperimentale* 1968, 118, 281 - 312
12. Riva, A. Aspetti ultrastrutturali delle ghiandole sottolinguali dell'uomo. *Arch. it. Anat. Embriol.* 1972, suppl. 74
13. Riva, A. & Riva-Testa, F. Fine structure of acinar cells of human parotid gland. *Anat. Rec.* 1973, 176, 149 - 166
14. Ruby, J.R. Ultrastructure of the parotid gland of the nine-banded armadillo. *Anat. Rec.* 1978, 192, 389 - 406
15. Ryter, A. & Kellenberger, E. L'inclusion au polyester pour l'ultramicrotomie. *J. Ultrastruct. Res.* 1958, 2, 200 - 214
16. Shackleford, J.M. & Wilborn, W.H. Structural and histochemical diversity in mammal-

- ian salivary glands. *Ala. J. Med. Sci.* 1968, 5, 180 - 203
17. Tandler, B. Microstructure of salivary glands. In: *Salivary glands and their structure*. N. H. Rowe, ed. University of Michigan Press, Ann Arbor 1972, 8 - 21
 18. Tandler, B. & Erlandson, R.A. Ultrastructure of the human submaxillary gland. IV. Serous granules. *Am. J. Anat.* 1972, 135, 419 - 434