nitro group in the molecule, the lack of mutagenicity in our tests and the high degree of activity make this series interesting as antiamebic agents and further evaluation is in progress.

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Association of intermediate filaments with other cell organelles in carcinoid tumor of the colon[1]

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Summary. Carcinoid tumor of the colon was studied in electron microscope. In cytoplasm, prominent intermediate-sized filaments were seen frequently attaching to nucleus and mitochondria. Direct contacts of intermediate filaments with secretory granules were not observed.

Intermediate filaments, microfilaments and microtubules form the cellular cytoskeleton[2-4]. The function of microfilaments and microtubules has been extensively studied[5,6] while the role of intermediate filaments is still incompletely known. They have been suggested to have mainly a skeletal, cell-supporting function[7] and we have recently shown that intermediate filaments are of major importance in nuclear anchorage[8]. However, there are also suggestions proposing a role for intermediate filaments in movement cell organelles[9], e.g. in neuronal cells[10], and in melanocytes[11].

Intermediate filaments seem to be increased in number in neoplastic cells[12], offering an opportunity to study their relationship to other cell organelles better than in normal

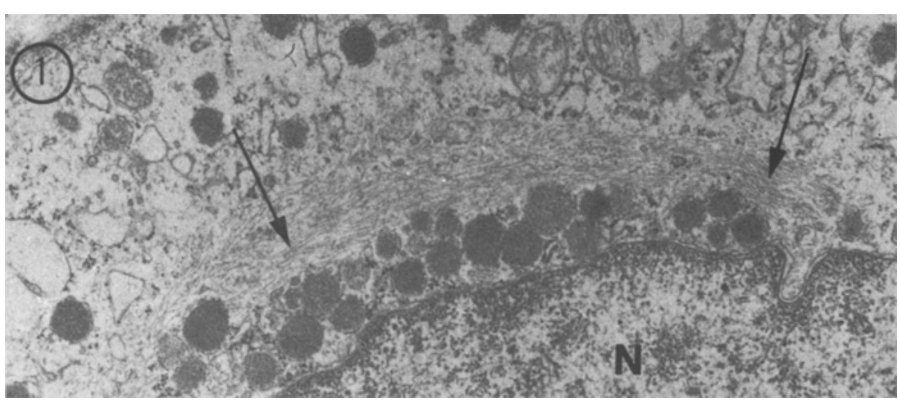

Fig. 1. Intermediate filaments form a prominent perinuclear bundle (arrows) which seems to displace the secretory granules. N, nucleus. × 18,500.

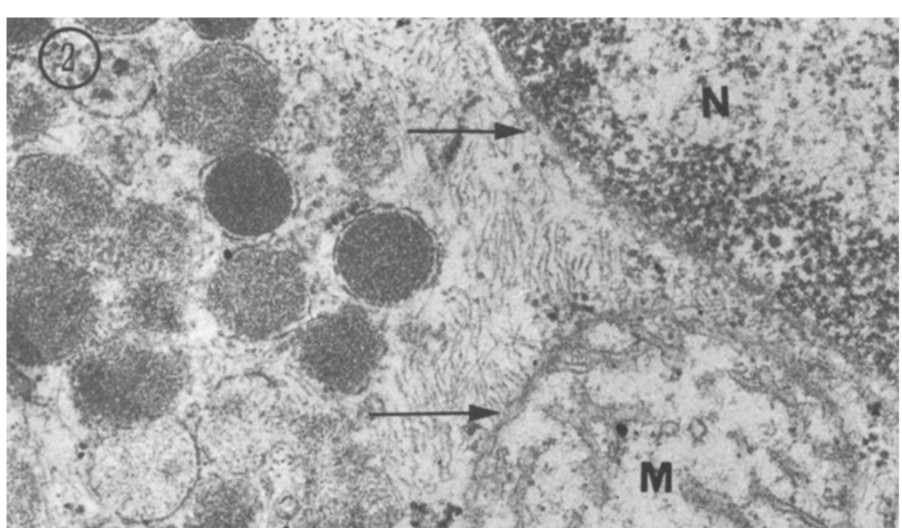

Fig. 2. Intermediate filaments are seen to attach to nucleus and mitochondrion. At the attachment sites, the membranes have a fuzzy appearance (arrows). N, nucleus; M, mitochondrion. × 46,000.

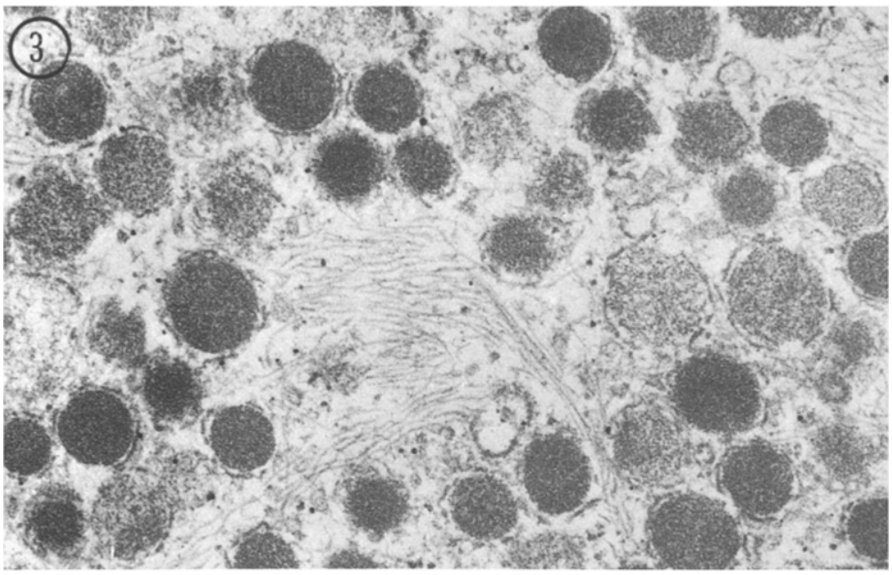

Fig. 3. Secretory granules in a network of intermediate filaments. Note lack of direct contacts. ×46,000.

cells. Here we have studied, at the ultrastructural level, a carcinoid tumor of the colon, where the intermediate filaments seem to be especially abundant, and have tried to evaluate the association of intermediate filaments with other cell organelles.

A specimen of a carcinoid tumor of colon was removed at surgery from a 47-year-old male. The sample was first fixed in 4.5% neutral formalin and after histological diagnosis immediately fixed further in 3.5% glutaraldehyde buffered with a 0.1 M Na-cacodylate, pH 7.2. The samples were postfixed in 1% osmium tetroxide, dehydrated and embedded in Epon 812. Thin-sections were stained with uranyl acetate and lead citrate, and studied in Jeol 100 B electron microscope at an accelerating voltage of 80 kV at the Department of Electron microscopy, University of Helsinki.

In electron microscopy, the tumor cells had a well preserved ultrastructure. In perinuclear areas, intermediate filaments often formed thick bundles which seemed to displace the secretory granules and trap them between the nucleus and the filament bundles (figure 1). Sometimes intermediate filaments were seen to attach to nuclear surface (figure 2) and notably to mitochondria. A large portion of the cytoplasm was occupied by secretory granules surrounded by a single membrane. Intermediate filaments were seen between the secretory granules as a distinct network. However, direct contacts between the filaments and the secretory granules could not be demonstrated (figure 3).

Our results show that intermediate filaments attach both to nuclei and mitochondria of the argentaffin cells. This kind of association was also reported earlier in macrophages and monocytes[13], although the filaments were not designed as intermediate filaments at that time (DePetris, personal communication).

These results support the suggestion that intermediate filaments have mainly a cytoplasmic skeletal function[7,8]. This does not exclude, however, the possibility that intermediate filaments also have a role in saltatory movements of mitochondria[9]. This might be accomplished, for instance, by the suggested association of intermediate filaments with microtubules[9,14].

In this study we could not find any connections between the intermediate filaments and the secretory granules which were seen in filamentous network. This is in line with other studies where usually microfilaments, based on morphological studies[15,16] or microtubules, based on functional studies[17], have been suggested to play a role in the secretion phenomenon.

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