‘Spitzenkörper’ in the Invasive Pseudohyphae of *Candida albicans*

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ABSTRACT. Ultrastructural investigation of the invasive phase of *Candida albicans* has brought to light densely staining, apical bodies or ‘Spitzenkörper’ which are most likely to be concerned with the apical extension of the fungus.

Ultrastructural interpretation of ‘Spitzenkörper’ in the hyphal tips of fungi has been a matter of some controversy. Optical microscope observations by Brunswick (2) showed the presence of densely-staining apical bodies with a rather diffuse outline in the hyphae of *Coprinus* species, which he called ‘Spitzenkörper’ bodies. Thirty years later, Girbardt (3, 4) identified similar structures in the growing tips of some Basidiomycetes and Ascomycetes.

Ultrastructural observations by McClure, Park and Robinson (8) in the hyphal tips of *Aspergillus niger* showed that the ‘Spitzenkörper’ was an aggregate of small apical cytoplasmic vesicles. Subsequent studies by Brenner and Carroll (1), Girbardt (5), Grove, Bracker and Morre (6), Grove and Bracker (7) confirmed the peculiar aggregation of apical cytoplasmic vesicles in the hyphae of various fungi.

In our investigation on the ultrastructure of the invasive phase of *Candida albicans*, we have observed electron dense apical bodies in some of the pseudohyphae. These bodies certainly do not appear to be an aggregate of apical vesicles. All previous studies on the ‘Spitzenkörper’ have been concentrated on fungi grown in vitro. In those instances, fixation for ultrastructural studies have been that the pseudohyphae were directly exposed to the fixative and as such the dense apical bodies observed in the optical microscope may have got dispersed due to the influence of direct fixation.

In this study the specimens were taken from oral lesions of patients with either acute or chronic candida infections. The white plaque was detached by firm scraping with the short edge of a glass microscope slide and the material transferred immediately into Palade's (9) osmium tetroxide, buffered with veronal acetate to pH 7.4 at 5°C for 2 hours. The material was dehydrated in graded ethyl alcohols, cleared in propylene oxide and embedded in hard grade Taab resin. Sections were cut on an L.K.B. ultratome at 60 to 90 nm and mounted on cleaned, uncoated copper grids. They were then stained in uranyl acetate and lead citrate. The grids were examined and photographed using a Jeol 100B electron microscope at 60 kV.

In our studies the pseudohyphae were invasive and as such within the host epithelial cells. Fixation in this case was indirect and a gradual process, whereby the fixative reached the interior of the invasive pseudohyphae via the host epithelial cell and the cell wall layers of the fungus. This method of fixation may account for the perfect preservation of these dense apical bodies.

Fig. 1. Electron micrograph of a pseudohypha of *Candida albicans* within a human epithelial cell showing the densely stained 'Spitzenkörper,' 'Spitzenkörper' (SZB); Cell wall (CW); Endoplasmic reticulum (ER); Tonofilaments (TF); Cytoplasmic vesicles (CV); Plasma membrane (PM). $\times 28,000$.

The presence of these bodies in only some of the pseudohyphae and their position in relation to the hyphae suggests that they play a definite role in apical extension than in wall growth.

An examination is being made to find whether these apical bodies (Spitzenkörper) could be identified and demonstrated ultrastructurally in other invasive fungi.

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