Electron Microscopy in Bone Tumor Diagnosis *
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I. Introduction

Recent developments in electron microscopy in the field of clinical pathology have illustrated a firmly established role for the electron microscope in the routine of diagnostic pathology. It will not and cannot displace the optical microscope as a diagnostic tool, however, and so light and electron microscopic examinations of biopsy material are complementary. Whereas the light microscope enables us to examine a wide area of the specimen, electron microscopy with its greater resolution adds important details, that facilitate and substantiate the correct differential diagnosis.

Electron microscopy as an additional diagnostic approach has been applied to a wide range of diagnostic problems in human pathology (Themann 1980). In recent years it has become apparent that it is particularly the differential diagnosis of tumors that may be considerably improved and enriched by electron microscopic studies. A

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monograph of diagnostic electron microscopy of tumors was published last year by Ghadially (1980).

This contribution concerns the potential value of EM examination in the differential diagnosis of human bone tumors. Neoplasms of bone and tumor-like skeletal diseases present many diagnostic problems and it is accepted that the correct histopathological diagnosis of a bone tumor requires in addition examination of the clinical features and radiological picture.

Several larger monographs on bone tumor diagnosis have been published in recent years (Dahlin 1978; Huvos 1979; Mirra 1980; Schajowicz 1981). These excellent books represent the current status of knowledge in bone tumor cytogenesis and differential diagnosis. They are mainly based on radiological and histological data and the additional possibilities of electron microscopy in cytological analysis and differential diagnosis are less well represented. This may be due to the continuing gap between clinical pathology and the most recent developments of ultrastructural pathology, a gap which the present paper attempts to bridge in the area of bone tumor diagnosis.

Obviously, electron microscopic examination of a bone tumor will not always add information useful in its diagnosis. Decisions of whether a bone tumor is benign or malignant cannot usually be substantiated by the ultrastructural appearance of its tumor cells, with the exception of some chondroblastic tumors: here malignant tumor cells are supposed to differ from benign chondroblastic tumor cells in the ultrastructure of their respective organelles. In most cases, however, EM investigation of tumor cells is no help in resolving the problem “benign or malignant?” since there is no specific ultrastructural feature that would characterize a cell as being malignant. This is particularly true in mesenchymal tumors wherein the irregular shape of the nucleus has limited value as a possible sign of increasing malignancy. In proliferating connective tissue, for instance, the mesenchymal cells may contain nuclei whose ultrastructural outline is so strongly invaginated and irregular as to support a mistaken conclusion in favor of malignancy. Careful light microscopic scrutiny of the respective tissue area will, however, illustrate the reactive nature of the tissue changes.

As a rule, the electron microscopic examination of tumor tissue will be of value in facilitating the subclassification of tumors whose light microscopic appearance permits only a rather gross division into spindle cell tumors, round cell tumors, or giant-cell-producing tumors.

After a brief survey of our material we shall discuss specific problems of differential diagnosis in those bone tumor types and cases wherein electron microscopic investigation can be a helpful tool.

II. Materials and Methods

All bone tumors discussed in this paper belong to a collection of 220 selected from the large material documented in “Knochengeschwulstregister Westfalen” (Westphalian Bone Tumor Registry), for special electron microscopic work-up over the last five years. These tumors were prepared for electron microscopy according to the standard method: Fixed in 2.25% glutaraldehyde (0.05 molar phosphate buffer, pH 7.4) for 2 hrs at 4°C, the specimens were then rinsed in the buffer for 24 hrs, and post-