Carbohydrate-rich tissue components in lung cancer and in normal bronchial tissues: a histochemical study

L. Kalevi Korhonen and Veikko Mäkelä

II Department of Pathology, University of Helsinki, Finland

Received 10 April 1968

Synopsis. The carbohydrate-rich compounds in bronchopulmonary neoplasms and in non-neoplastic tissue have been characterized histochemically. Glycogen was present in few epidermoid and large-cell carcinomas. Epithelial mucosubstances were produced by adeno-, mucoepidermoid, and large-cell carcinomas. The mucosubstances produced by carcinoma cells had characteristics different from those occurring in normal tissue. The most striking characteristic was the presence of a sialidase-labile compound in certain neoplasms.

Hyaluronic acid was present in the stroma of the carcinomas. In a third of the cases studied, chondroitin sulphates were also present. Higher sulphated compounds were observed as well. This stromal reaction was correlated with the occurrence of a round cell reaction, but not with mast cells. This was considered to indicate the production of stromal material and fibres, but it can also explain the high levels of carbohydrate-rich substances in serum and urine in cases where neoplastic tissue itself does not produce such substances. It also agrees with the theory of carbohydrate-rich compounds acting as a 'barrier' preventing immunological reactions against neoplastic cells.

Introduction

The levels of hexosamine-rich substances and hyaluronidase inhibitors in serum and urine are known to increase in patients with neoplastic diseases and in other pathological conditions (Kiriluk et al., 1950; Winzler, 1955). They decrease to normal with successful treatment or remain elevated if treatment proves unsuccessful. Consequently a certain diagnostic and prognostic significance has been ascribed to mucoprotein determinations, although at present 124
Carbohydrate-rich substances in bronchial tissues

their significance seems to be doubtful (Kolar & Kadlecova, 1967). Virtually nothing is known about the sites of formation of these substances. Seibert et al. (1947) have suggested that the elevations of serum glycoprotein levels are associated with tissue destruction and Shetlar et al. (1950) that the changes indicate tissue proliferation. Kizer & McCoy (1959) have shown that hexosamine synthesis takes place in sarcoma cell homogenates.

Several investigations have dealt with the occurrence of carbohydrate-rich compounds in malignant tumours. Discussing their biological significance, Currie & Bagshawe (1967) and Kirby & Wood (1967) suggested that the presence of a carbohydrate-containing 'coat' around the malignant cells could act as a barrier, preventing the immunological reaction of the host tissue against the neoplastic cells. It has also been suggested that the same kind of system exists around trophoblasts to prevent the immunological rejection of the embryo as a 'foreign body'.

The carbohydrate-rich substances which occur in lung neoplasms are significant in histological classifications. In a preliminary investigation Korhonen et al. (1968) presented observations of carbohydrate-rich compounds in normal bronchial tree as well as in inflammatory and neoplastic conditions. In the present study, additional characteristics of carbohydrate-rich tissue components (referred to as mucosubstances in the present investigation) in the pulmonary neoplasms are described. Histochemical studies are particularly suitable for this purpose, because it is not possible to obtain sufficient quantities of pure samples of certain secretory cell types for conventional biochemical analyses.

Materials and methods

The material used in this study was obtained from surgical biopsies of 47 patients operated for lung neoplasms during the years 1966-1967, mainly at the University Clinics of Helsinki, Finland. Only a part of the biopsy material available was used; that selected represented some major morphological variants of lung neoplasms. A detailed presentation of the material is given in table 2. The biopsies were fixed in neutral formalin and embedded in paraffin by routine methods, using alcohol dehydration and benzene clearing in an 18 hr programme in an automatic tissue processor. Sections of thickness 3 to 5 μ were mounted on glass slides without adhesives.

The staining methods used were the conventional Haematoxylin–Eosin (H-E), orcein–Weigert–van Gieson, and silver impregnation methods for the demonstration of the overall morphology and the connective tissue stroma.

Mast cells were counted in the central areas of the tumour samples, perivascular and peribronchial areas being avoided. Using a medium-power objective the number of mast cells was counted in 5 random fields. A finding