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Scanning Electron Microscopy of Hyperplastic and Neoplastic Human Prostate*

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Summary. Acinar cells of neoplastic prostate tissues are more heterogeneous in size and shape than benign hyperplastic cells when observed by scanning electron microscopy. Three types of acinar cells are recognizable by surface structure, cells with microvilli, cells without microvilli, and cells with membrane ruffles. The pitted cells previously seen in BPH tissues are probably artifactual. The identity of the crater cells is still in question.

Key words: Benign prostatic hyperplasia, Prostatic adenocarcinoma, Scanning electron microscopy.

Though the ultrastructure of the human prostate has been examined extensively with transmission electron microscopy (1, 4, 5, 6, 8, 9, 10, 11) only two previous studies have utilized scanning electron microscopy (2, 3). These studies compared the acini and acinar cells of normal, control prostate with those of tissue exhibiting benign prostatic hyperplasia (BPH).

In the following study, benign hyperplastic and malignant prostatic acini were examined by scanning electron microscopy to determine if this method would differentiate between normal, benign, and malignant acinar cells. The acini and acinar cells from both types of tissues are described and differences noted.

MATERIALS AND METHODS

Prostate specimens were obtained from patients with either BPH or adenocarcinoma of the prostate. Tissues were fixed in 5% glutaraldehyde in 0.1 M sodium cacodylate buffer (pH 7.4) at room temperature for 1 hour, then stored at 0° C for 24 h. Samples were fixed immediately following excision from the patient, or within an hour of surgery. After fixation the tissues were cut into sections approximately 1 mm thick with razor blades. These sections were stained with 1 part Giemsa solution (Fisher Scientific Company) to 20 parts 0.07 M sodium phosphate buffer, pH 7.0. The stained sections were either photographed or sketched so that areas characteristic of BPH or prostate adenocarcinoma could be positively identified when the samples were scanned.

Tissues for scanning electron microscopy were dehydrated by washing in 50, 75, 85 and 95% ethanol at 15 min intervals followed by two absolute ethanol rinses. The tissues were then processed through 75% absolute ethanol/25% Freon 113, 50% absolute ethanol/50% Freon 113, 25% absolute ethanol/75% Freon 113, and three washes of Freon 113 at 15 minute intervals. The samples were critical point dried with liquid CO_2 (Denton Vacuum) using Freon 113 as the transition fluid. The samples were rotary coated in a JEOL evaporator with carbon and platinum and viewed in an Etec Autoscan scanning electron microscope. The micrographs were recorded on Polaroid P/N 55 film (Polaroid Corporation).

Cryostat sections of the tissues were stained with hematoxylin and eosin (12) to determine tissue pathology.

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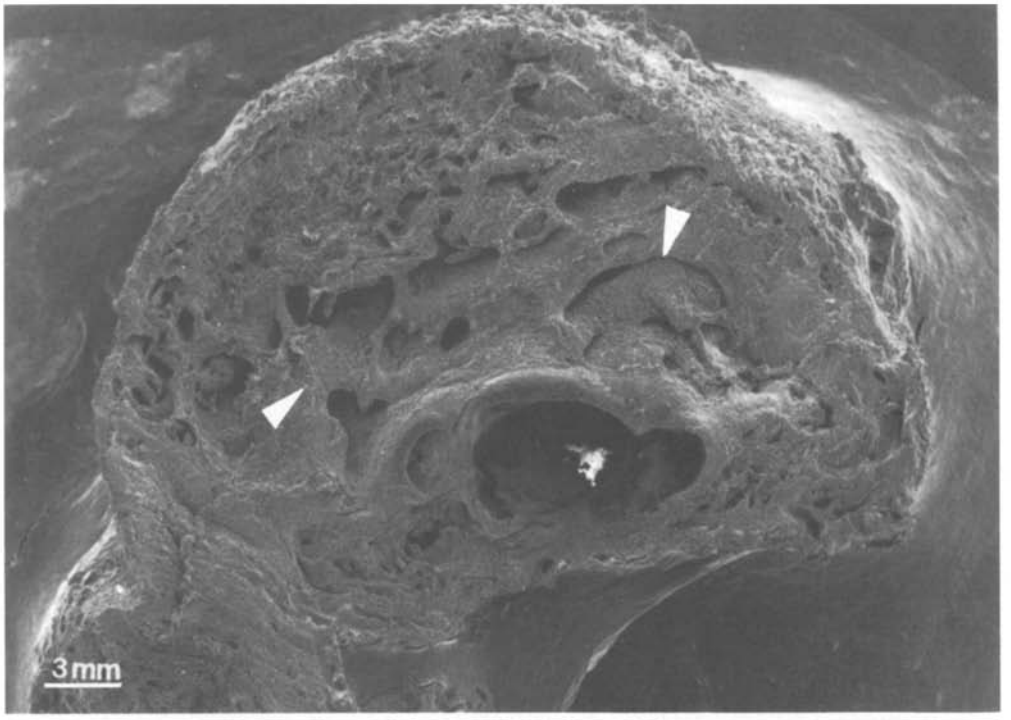

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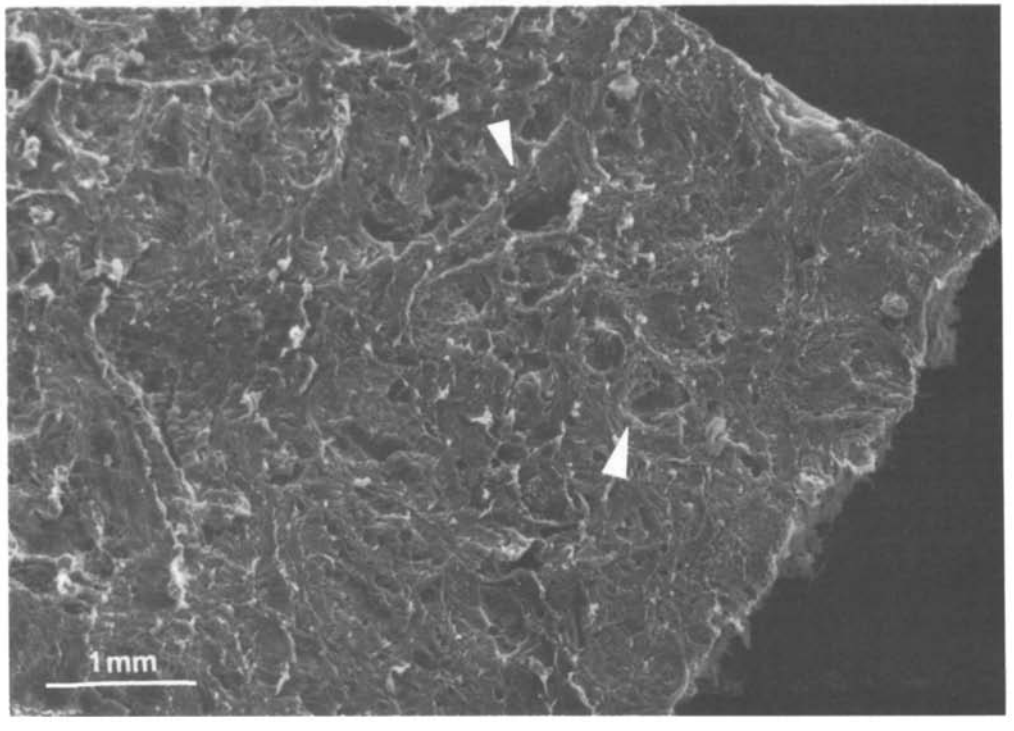

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Fig. 1. A scanning electron micrograph of a section of benign hyperplastic tissue. The large acini are indicated by arrows

Fig. 2. A scanning electron micrograph of a section of an adenocarcinoma. The small acini characteristic of this tissue are indicated by arrows

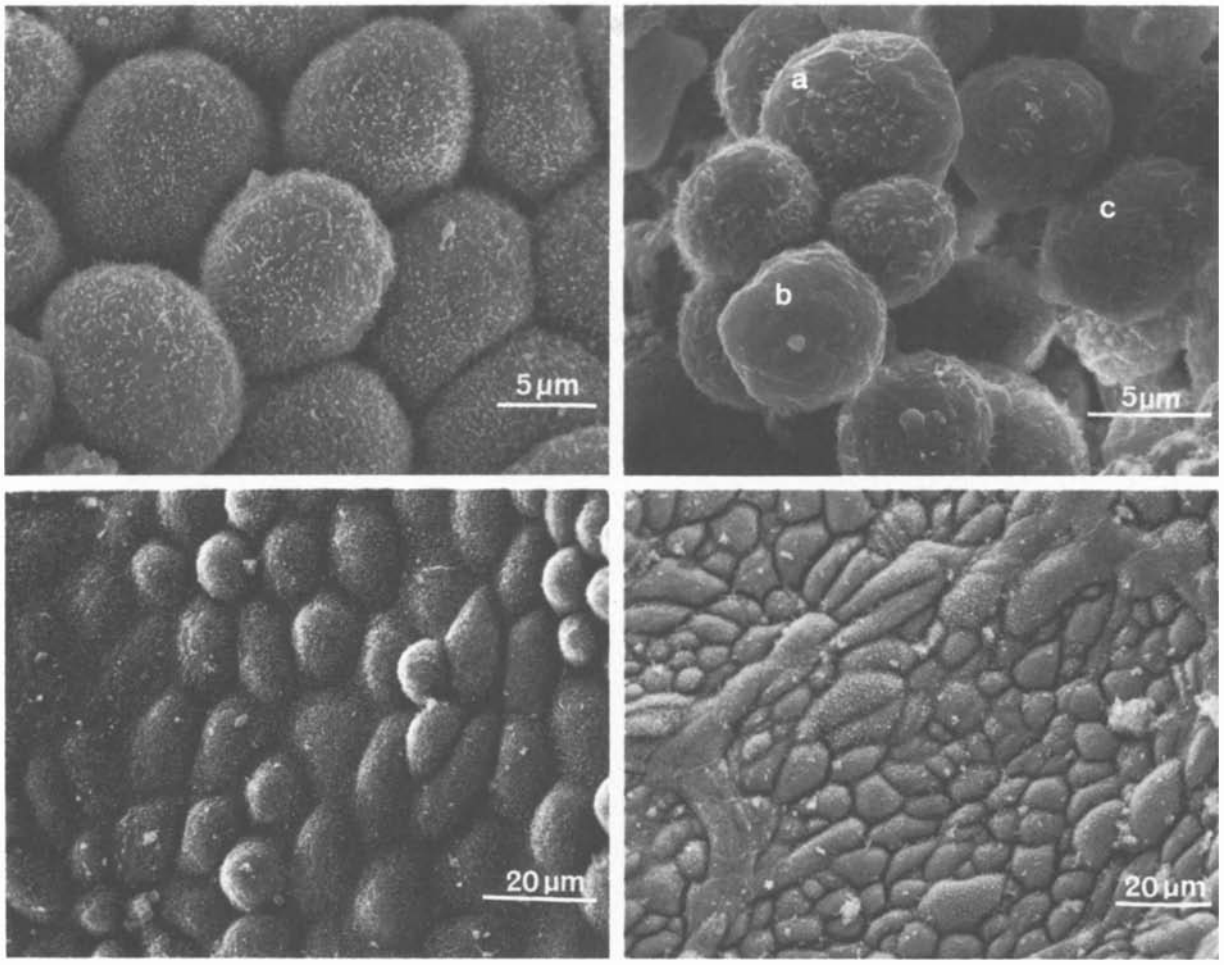

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Fig. 3. A scanning electron micrograph of several cells in a BPH acinus. The cells appear fairly homogeneous in size and shape. They are covered by short microvilli

Fig. 4. A scanning electron micrograph of several cells in a prostatic adenocarcinoma sample. The epithelial cells are present in cords in this sample. The cells illustrate the 3 different types of surface morphologies we have identified on both BPH and adenocarcinoma acinar cells, cells with microvilli (a), cells without microvilli (b), and cells with membrane ruffles (c)

Fig. 5. A scanning electron micrograph of acinar cells in a BPH tissue. Rounded cells appear with flat cells in the same portion of an acinus. These cells are covered with short microvilli, as well as secretory debris

Fig. 6. A scanning electron micrograph of a sheet of cells in prostatic adenocarcinoma. The disordered arrangement of the acinar cells is evident, as is the heterogeneous size and shape of the acinar cells

OBSERVATIONS

Benign prostatic hyperplasia. Fig. 1 is a scanning electron micrograph of benign prostatic hyperplastic tissue. It demonstrates the classic histologic appearance of large irregular acini lined with glandular epithelium and surrounded by abundant stroma (glands indicated by arrows). Representative BPH areas can be identified, and orientation and position of the sample can be maintained at higher magnifications as in Fig. 3 and 5. The majority of cells lining the acini appear to be either tall columnar or low columnar (10) and in the SEM appear rounded as in Fig. 3. Flat cells, probably corresponding to cuboidal cells (10), are evident in other areas of the same gland (Fig. 5). In Fig. 3 and 5 the surfaces of acinar cells are covered with short microvilli.

Adenocarcinoma. Fig. 2 is a scanning electron micrograph of a prostatic adenocarcinoma sample. The small, closely packed glands of the carcinoma region are indicated by arrows. The adenocarcinoma acinar cells may be found in a rounded form, as in Fig. 4, or in many poorly differentiated adenocarcinomas the malignant cells appear flat in the SEM (Fig. 6). In Fig. 4 cells with microvilli, cells with no microvilli, and cells with ruffled membranes are present, these cell types are representative of the cell surface morphologies we find in acinar cells of both hyperplastic and neoplastic tissues.

DISCUSSION

The prostate is composed of two major elements, the epithelial or acinar, and the stromal. The acinus is lined by either tall columnar, low columnar, or cuboidal epithelial cells which can be easily distinguished morphologically in the SEM from the stromal elements which consist of smooth muscle cells, elongated fibrocytes with thin cytoplasmic processes, and bundles of collagen (10). It is also possible to identify individual types of acinar cells such as tall columnar cells and cuboidal cells (Fig. 3 and 5).

In addition, differences between the acinar cells of benign hyperplastic and neoplastic prostatic tissue can be discerned. Though areas of heterogeneous acinar cells can be seen in BPH tissues, the acinar cells of neoplastic prostate are consistently more heterogeneous in size and shape than the acinar cells of benign hyperplastic tissues.

Surface details as viewed in the SEM do not now provide distinguishing characteristics either among types of acinar cells or among the different types of prostatic tissue examined. We have identified three types of cells on the basis of surface characteristics, including cells with microvilli, cells with no microvilli, and cells with membrane ruffles. All three types of cells exhibit varying amounts of folds in the cell membrane which is validated by previous TEM studies (1, 5, 10). There is not at this time a correlation between a distinctive cell surface morphology and the pathology of the tissue; however more prostatic adenocarcinomas must be viewed to rule out the possibility that such a correlation exists.

Clark et al. (2, 3) in previous scanning studies of the prostate described three types of acinar cells based on surface details, microvillar, crater and pitted cells, and found an association between benign hyperplasia and the presence of pitted cells. We find few crater or pitted cells. We find that the number of pitted cells appearing is dependent upon the manner in which the sample is coated; sputter coating can cause damage to the sample (7).

Crater cells appear as less than 1% of the total acinar cell population in our samples opposed to the 10 to 20% found by Clark et al. (3). We attribute the appearance of crater in our samples to damage occurring in processing for scanning electron microscopy or to the possibility that the cell is actively secreting. We are now studying the latter possibility attempting to correlate acinar cell surface structure with cell viability and secretory activity by combining electron microscopy and light microscopy with histochemical staining procedures.

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