

Cancer of the oral epithelium located in the upper gingiva in the light of research of energy dispersive X-ray analysis method First report

TADEUSZ CIEŚLIK, AGATA CIEŚLIK, ANNA NAMYSŁOWSKA

I Department and Clinic of Maxillofacial Surgery, Silesian Medical Academy,
ul. Buchenwaldczyków 19, 41-800 Zabrze, Poland

DANIEL SABAT, TOMASZ J. MĘCIK, ZBIGNIEW SZCZUREK

I Department of Pathomorphology, Silesian Medical Academy,
ul. 3 Maja 13/15, 41-800 Zabrze, Poland

A phenomenon of cancerous changes is one of the most difficult diagnostic and therapeutic challenges of contemporary medicine. In this paper, we have described the method which can contribute to further development of cooperation between medical doctors and physicists. We have analyzed 6 cases of cancer located in the upper gingiva using EDX method. All patients (4 males and 2 females) were diagnosed in the 1st Department and Clinic of Maxillofacial Surgery, Silesian Medical Academy in Zabrze.

The authors observed the changes in the quality and the quantity of mineral composition of healthy and cancerous oral epithelia. The size of oral epithelium carcinoma in the clinical diagnosis was essentially connected with the concentration of calcium which developed into visible forms. This research will be continued, firstly, because of a small group of the patients examined and secondly, because the observed concentrations of calcium, sulphur and phosphorus have been substantially higher in the group of patients with advanced clinical forms of the cancer. We think that this physical method could help in early diagnostics and monitoring of the cancer located in the upper gingiva.

Key words: cancer of the gingiva, energy dispersive X-ray analysis

1. Introduction

Cancerous changes pose one of the most difficult diagnostic and therapeutic challenges of modern medicine. In Poland, according to the Institute of Oncology in

Warsaw, a constant rise in cancer incidence, including oral cavity, has been observed [17]–[21]. Despite a continuous progress in the neoplasm pathophysiology and the improvement in patient's care and social education, hardly any progress in five-year survivals can be noticed [4]–[7]. As far as oral cavity is concerned, some articles on new carcinoma markers have appeared in recent years. At present protein p53 is one of very popular markers [15]. As a marker of a squamous cell carcinoma p53 has slightly higher sensitivity and specificity in clinical confirmation of the cancer, ranging up to 70% [3], [8], [14].

The benefits resulting from interdisciplinary cooperation of scientific teams in recognizing neoplasms are very well and widely acknowledged. In this study, a method that can contribute to the further development of cooperation between physicists and physicians in learning about human pathology is described.

The aim of the study was to evaluate some chosen physical and chemical parameters of patients with squamous cell carcinoma of the upper gingiva.

2. Material and method

6 cases of squamous cell carcinoma of the upper gingiva in 4 males and 2 females were examined. All the patients were diagnosed in the Medical University Hospital and Department of Maxillofacial Surgery in Zabrze. The control group consisted of 4 patients with healthy mucous membrane of the oral cavity that was collected while doing a routine preparation of soft tissue during a surgical extracting the unerupted third molar tooth.

All the patients were subjected to histopathological examinations of the gingiva – a routine diagnosing procedure in the examination of the soft tissue samples. Next, EDX analysis of the element content in each sample was made taking account of the sex, age and size of the neoplastic change. EDX analysis is based on the evaluation of energy spectrum of sample dispersed radiation. It was performed using the microscope JEOL JSM 5400 and included the point and surface analyses and of all the samples examined. The phenomena observed were presented in the proper diagrams.

3. Results

Both qualitative and quantitative differences in the element content in the healthy mucous membrane and the membrane changed by disease were observed (figures 1 and 2).

Calcium, sulphur and phosphorus contents were significantly higher than potassium, sodium, magnesium and iron contents. Silicon came from base glasses where preparations were placed – its concentrations were identical in experimental and con-

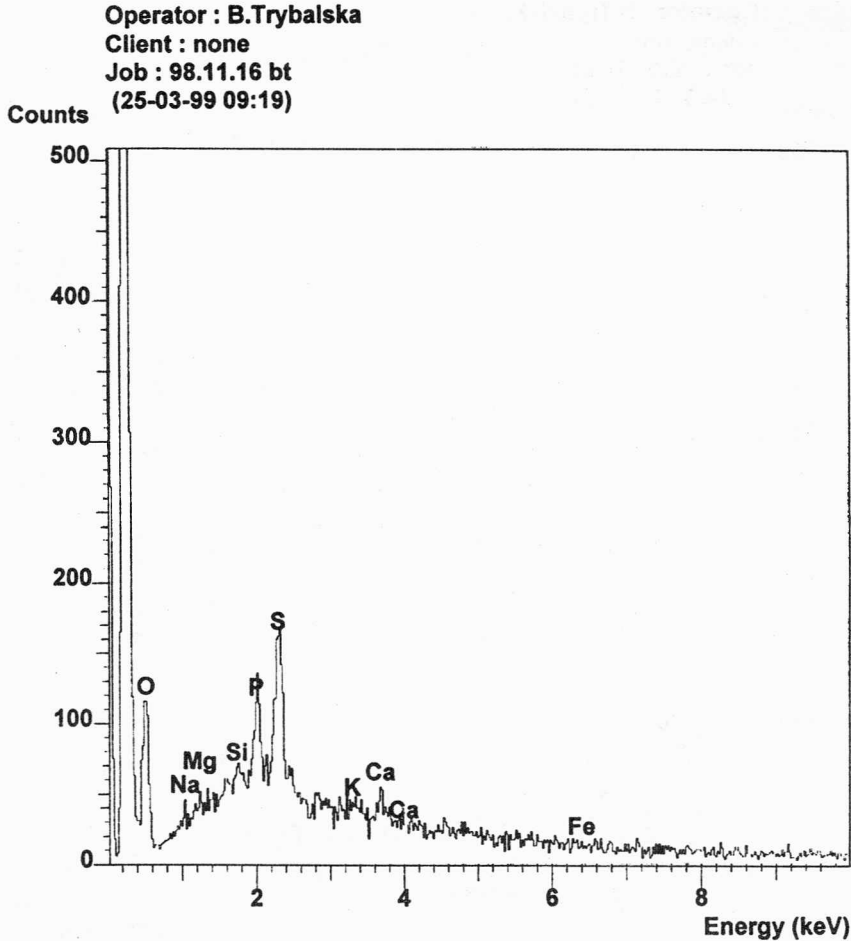


Fig. 1. Superficial distribution of chemical components in experimental and control groups. Magn. approx. 5000×

trol groups. In the group of six patients with squamous cell carcinoma of upper gingiva, no significant dependences between sex and age on the one hand and changes in the element contents were observed, which would suggest their cyclic occurrence. It is worth noting that the magnitude of changes caused by squamous cell carcinoma evaluated in a clinical examination was significantly related to a calcium concentration that manifested itself as clearly visible granules (figures 3 and 4).

4. Discussion

The results of our examination prove that the differences between healthy and sick people appear not only in clinical and morphological picture of their upper gin-

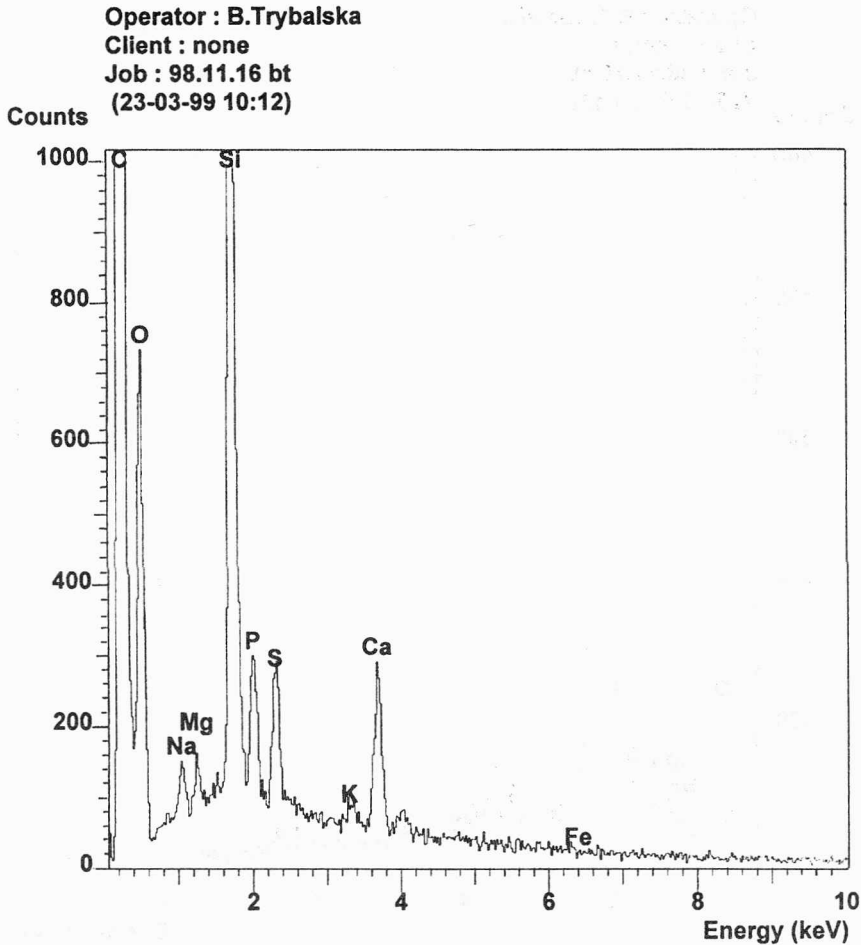


Fig. 2. Superficial distribution of chemical components from the carcinoma area.
 Male with cancer of the gingiva. Magn. approx. 5000×

giva, but also in quality and quantity of elements in this tissue. The other authors' studies concerning colon and larynx cancer confirmed our observations about the changes in the element contents [9]–[12], [16]. Each of them underlines the usefulness of the X-ray analysis technique in the cancer diagnosis. There was a unified opinion on a calcification of neoplastic tissues in the case of ovarian cancer or breast cancer [1], [2], [13]. In the above studies, a high level of calcium, which was accompanied by high concentrations of phosphorus and magnesium, was found within the area affected by neoplasm.

To sum up – due to a small number of the examined samples of upper gingival squamous cell carcinoma and no articles on this subject, it is difficult to draw definite conclusions confirming the usefulness of EDX as a diagnostic method. These

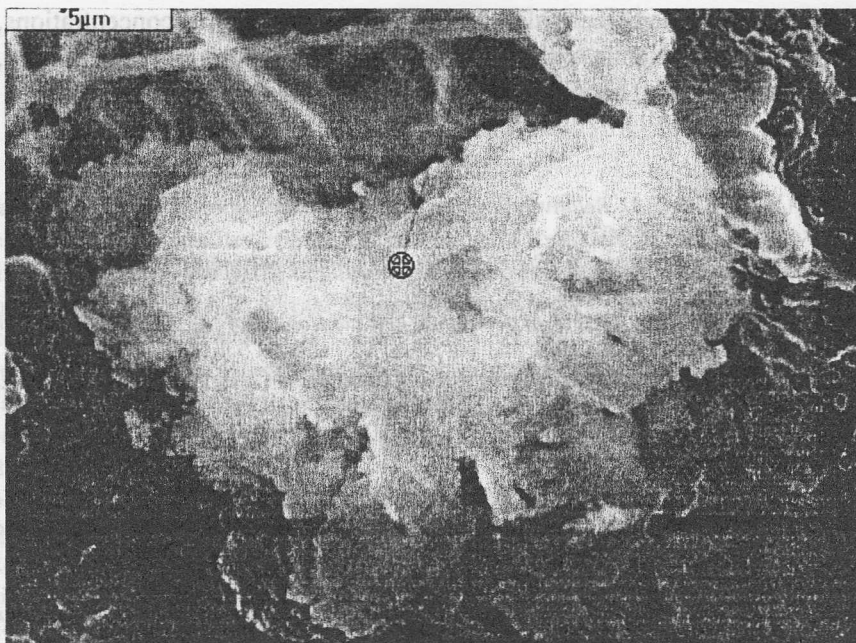


Fig. 3. Conglomeration of calcium in mineral granule from the carcinoma area.
Male with cancer of the gingiva. Magn. approx. 5000× (SEM)

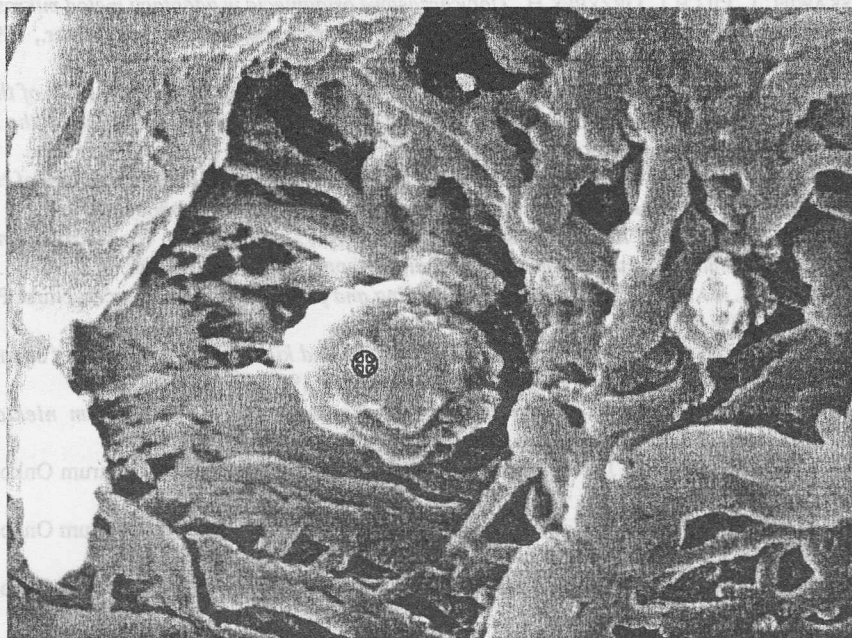


Fig. 4. Conglomeration of calcium in mineral granule from the carcinoma area.
Female with cancer of the gingiva. Magn. approx. 5000× (SEM)

studies will be continued since calcium, sulphur and phosphorus concentrations, significantly higher in patients with clinically advanced upper gingiva neoplasm, can be helpful in monitoring neoplastic disease and its possible recurrence.

References

- [1] CHAUBAL L., REGER B.J., *Relatively high calcium is localized in cancer cells in ovaries*, Sex Plant. Repr., 1990, 3, 98–102.
- [2] FLORIAŃCZYK B., PASTERNAK K., *Stężenie magnezu i cynku w raku sutka*, Biul. Magnezjol., 1994, 4, 54–63.
- [3] KIM J., SHIN D.M., *Biomarkers of squamous cell carcinoma of the head and neck*, Histol. Histopathol., 1997, 12, 1, 205–218.
- [4] KRYSZTA L., *Strategia leczenia raków jamy ustnej*, Onkologia w Chirurgii Szcękowo-Twarzowej. II Sympozjum Onkologia Chirurgiczna, Warszawa, 1993, II, 3–18.
- [5] KRYSZTA L., *Rak płaskonabłonkowy jamy ustnej – etiologia i epidemiologia*, Mag. Stom., 1995, 5, 11, 10–11.
- [6] KRYSZTA L., MEYZA J., *Zasady i wyniki leczenia raków jamy ustnej*, Mag. Stom., 1995, 5, 1, 10–16.
- [7] KUSOWASKI K., LEWANDOWSKI B., PERCZYŃSKA-PARTYKA W., ZIELIŃSKA B., *Badania świadomości zdrowotnej dotyczącej choroby nowotworowej szczęk, jamy ustnej i twarzy*, Czas. Stomat., 1993, 46, 2/3, 138–141.
- [8] KUROKAWA K., YAMASHITA H., TOKUDOME S., KAYIAMA M., *Combination assay for tumor markers in oral squamous cell carcinoma*, J. Oral Maxillofac. Surg., 1997, 55, 9, 964–966.
- [9] KUŚMIERSKI S., ŁASKAWIEC J., *Próba określenia zmian morfologii i zawartości metali ciężkich w limfocytach krwi obwodowej u ludzi zdrowych i z nowotworami jelita grubego metodą mikroanalizy rentgenowskiej*, 53 Zjazd Chirurgów Polskich, Poznań, 1987, 47–51.
- [10] ŁASKAWIEC J., PILCH J., GRZYBEK H., *Dotychczasowe osiągnięcia w adaptacji metod mikroskopii skaningowej i mikroanalizy rentgenowskiej dla potrzeb nauk medycznych*, Inż. Mater., 1992, 6, 139–142.
- [11] PILCH J., LISIEWICZ J., GIEREK T., ŁASKAWIEC J., TOMCZOK J., *The surface structure of the peripheral blood lymphocytes from patients with the laryngeal carcinoma evaluated by the scanning electron microscopy*, Aur. Nas. Larynx, 1988, 15, 43–49.
- [12] PILCH J., ŁASKAWIEC J., LISIEWICZ J., *The X-ray microanalysis method for investigation of chemical composition of normal and pathologic human peripheral blood lymphocytes*.
- [13] POSTOLSKI M., ROGALA J., ZAJKOWSKI P., WYSOCKI M., JAKUBOWSKI W., *Mikrozwapnienia w badaniu sonomammograficznym – doniesienie wstępne*, Ultras. Pol., 1996, 6, 2, 70–75.
- [14] SCHUGAR D.C., PATTON L.L., *Detecting, diagnosing and preventing of oral cancer*, Nurse Pract., 1997, 22, 6, 109–115.
- [15] SOMMER T., OLOFFSON J., *Significance of P-53, PCNA and ki-67 in the prognosis of squamous cell carcinoma of the oral cavity*, Laryngorhinootologie, 1997, 76, 3, 189–196.
- [16] WNUKIEWICZ J., *Zależność między rozwojem raka jamy ustnej a stężeniem niektórych mikroelementów w tkankach*, rozprawa habilitacyjna, Wrocław, 1990.
- [17] ZATOŃSKI W., TYCZYŃSKI J., *Nowotwory złośliwe w Polsce*, Wydawnictwo Centrum Onkologii, Warszawa, 1994.
- [18] ZATOŃSKI W., TYCZYŃSKI J., *Nowotwory złośliwe w Polsce*, Wydawnictwo Centrum Onkologii, Warszawa, 1995.
- [19] ZATOŃSKI W., TYCZYŃSKI J., *Nowotwory złośliwe w Polsce*, Wydawnictwo Centrum Onkologii, Warszawa, 1996.
- [20] ZATOŃSKI W., TYCZYŃSKI J., *Nowotwory złośliwe w Polsce*, Wydawnictwo Centrum Onkologii, Warszawa, 1997.
- [21] ZATOŃSKI W., TYCZYŃSKI J., *Nowotwory złośliwe w Polsce*, Wydawnictwo Centrum Onkologii, Warszawa, 1998.