Quantification of selected elements and speciation of iron in ovarian cancer tumours and their potential as a malignancies indicator.

Maria Magdalena Grzelak[1] , Paweł Marek Wróbel[1], Beata Ostachowicz[1] Łukasz Chmura[2], Dariusz Adamek[2], Marek Lankosz[1], Robert Jach[3] and Edmund Welter[4]
[1] AGH-University of Science and Technology, Faculty of Physics and Applied Computer Science, al. A. Mickiewicza 30, 30-059, Krakow,Poland
[2] Department of Pathomorphology, Faculty of Medicine, Jagiellonian University Medical College, ul. Grzegorzecka 16, 31-531 Krakow, Poland
[3] Department of Gynecology and Obstetrics, Faculty of Medicine, Jagiellonian University Medical College, ul. Kopernika 23, 31-501 Krakow, Poland
[4] Deutsches Elektronen-Synchrotron, Petra III Extension, P65, Hamburg, Germany
Maria.Grzelak@fis.agh.edu.pl

Introduction

Ovarian cancer is the seventh most common cancer among women worldwide, and mortality rates from this cancer are higher than for the other gynecological cancers. The process of cancerogenesis can disturb the normal operation of biochemical composition of the ovarian tissue. The element amounts and the oxidation states of transition metals within neoplastic cells may differ significantly from those in healthy, non-cancerous specimens. Iron plays an important role in Fenton's reaction: it controls the formation of reactive oxygen species which are a major cause of DNA damage. The aim of this study was to check if minor and trace elements and oxidation state of iron can be treated as ovarian cancer indicator.

Methods

The Total Reflection X-ray Fluorescence technique (TXRF) was chosen to analyze the concentration of elements in ovarian cancer samples. The samples designed to elemental analysis were taken intraoperatively from ovarian tumors and corresponding cyst fluids (if it was possible) of different degrees of malignancy. For the dissolving the tissues the pressure Parr bombs were used. The study was conducted at the Elettra Sincrotrone Trieste (Italy) and in the laboratory on the Faculty of Physics and Applied Computer Science (Nanohunter II Rigaku).

For Iron speciation analysis X-ray Absorption Spectroscopy (XANES) was used. The study was conducted at the Deutsches Elektronen-Synchrotron in Hamburg (DESY). The non-fixed tissue and cyst fluid were taken into account.

Results and discussion

The SR-TXRF technique revealed that low Z elements such as Na, Mg, P, S and Cl were presented in all samples analyzed. The laboratory TXRF method was able to determine the concentration of the elements such as: K, Ca, Ti, Cr, Mn, Fe, Cu, Zn, Se, Rb and Sr. Using the collected spectra the values of the Method Detection Limit (MDL) were determined. Statistical analysis of the measurement data was carried out with the STATISTICA package (version 10.1).

The Fe XANES spectra were collected at selected points of few different region of the samples. Using the Athena program from the IFEFFIT package, the background was subtracted from the spectra, and then the spectra were normalized. The energies of Fe absorption K-edge were calculated from the measured spectra with the using method of the mathematical center of

gravity. The position of Fe K-edge suggests that cystic fluids and cancer tissue contain both Fe^{2+} and Fe^{3+}, however a substantial is a fraction of Fe^{3+}.

Conclusion

For TXRF analysis significant differences in concentration of Se, Cr, Fe and Cu was observed. The statistical tests: Kruskal-Wallis test and U-Mann-Whitney test were validate this observations. Also the different composition of tissue and corresponding cyst fluids were identify.

In all of the analyzed samples, iron occurred in compounds with both Fe^{2+} and Fe^{3+} chemical forms. However, the ratio of Fe^{2+} and Fe^{3+}content in tissue was noticed to increase with the tumour malignancies.

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