PP-175

Multiple bone myeloma and amyloid-like protein formation. A spectroscopic study

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Introduction: Multiple myeloma is a blood cancer disease and the most common primary tumor of bones while 90% of patients develop bone lesions. In the present work we used infrared spectroscopy (IR) in combination with Scanning Electron microscopy (SEM-EDX) to study the changes of the molecular structure of blood and bones of patients due to diseases.

Methods: Blood and bone marrow samples were taken from 10 patients (age 50-67 years) who suffered from multiple bones myeloma. Two of them had a pathological fracture due to their disease and specimens from the fracture area were collected.

The FT-IR spectra were recorded with a Nicolet 6700 thermoscientific spectrometer (USA), equipped with an ATR-FT-IR apparatus. Each plot consisted of 120 co-added spectra at a spectral resolution of 4 cm^{-1} and the OMNIC 7.1 software was (from Nicolet 6700) used for data analysis. The advantage of IR spectroscopy is that it requires only few micrograms of samples.

Results: The IR spectra showed considerable changes in band intensities and shape between healthy and diseased samples in all spectral regions. It was found that the proteins change their structure from α-helix to random coil. Furthermore, in the bones it was found that amyloid-like proteins were produced due to the cancer, while the hydroxyapatite changed its biological structure to amorphous one. The amorphous structure is one of the risk factors for bone lesions and fractures.

In the spectra of all patients it was noticed from the bands at the region 850-800 cm-1 that the DNA changed its structure from the normal B-DNA to cancerous Z-DNA. SEM-EDX analysis showed the increase of total copper concentration in the serum and this was analogous to clinical data.

Conclusion: It was found that in multiple myeloma in the blood as well as in bones the molecular structure of proteins changes from α-helix to random coil, while in the bones amyloid-like proteins were produced. The native B-DNA form changed to Z-DNA. From the concentration of copper it was established that copper proteins are linked to DNA and protein damage due to electron transfer and free radical reactions.