Heavy metal analysis in lens and aqueous humor of cataract patients by total reflection X-ray fluorescence spectrometry

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Environmental pollution is becoming more ubiquitous and exposure to environmental toxins increases as a result. Some of the most notorious pollutants are heavy metals as these are often neither metabolized nor excreted, but rather deposited in the body. The human eye is continuously exposed to the environment yet little is known about how much of the toxins are present in its different parts and how they influence vision and acuity. To shed light into this subject, aqueous humor and lens samples were collected from 11 cataract patients to study the presence and concentration of heavy metals in the eye. Subjects undergoing routine cataract surgery were consecutively enrolled for study by simple random sampling. Prior to surgery, subject demographic were compiled. The surgical procedure involved small incision cataract removal using phacoemulsification. During the procedure a small aliquot of aqueous humor was retained for analysis. Lens analysis was performed by sampling the homogenized lens fragments obtained during phacoemulsification. A balanced salt solution was used as control for each set of samples. The ocular specimens were analyzed by total reflection X-ray fluorescence spectrometry after dilution and addition of an internal standard. The data obtained show substantial variations in elemental signature between the two media (aqueous humor and lens), and the patients themselves. Most common heavy metals in both types of media were chromium and nickel. Manganese and barium were found in lens, but not in aqueous tissue. Lead was found in some of the samples, however in very small quantities. Concentrations were generally higher in aqueous samples. Of note, larger body mass index (BMI) was found predictive of chromium in aqueous humor. Further study and increased sample size is required to more accurately elucidate the relationship between systemic and ocular heavy metal accumulation and the impact of heavy metal accumulation on measures of visual function as well as ocular and systemic disease.