Optical Pathology of Photoacoustic Spectra of Ovarian Tissue: Classification Using Principal Component Analysis (PCA) and Artificial Neural Network (ANN) Analysis

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In our laboratory, we have recorded the pulsed laser induced Photoacoustic spectra of pathologically certified normal, benign, and malignant ovarian tissues using a 325 nm excitation from a Nd-YAG-MOPO-FDO source (Quanta-Ray Spectra Pro-230-10, MOPO-730-SL, FDO-900, Spectra Physics). The photoacoustic signal was detected using a PZT transducer (PI-ceramic, Germany) coupled to a homemade PA cell. Signal accumulation was done using a transient digitizer (EG&G Model 9846). Photoacoustic signals recorded in the time domain using a transient digitizer were Fourier transformed into the frequency domain by MATLAB® algorithms. For the classification of different pathological conditions of ovarian tissues, artificial neural network (ANN) with a back propagation algorithm is used. Feature spaces for classification, including mean, median, sum, spectral residuals, maximum intensity, and standard deviation, etc., were extracted from each spectrum. Principal Component Analysis (PCA) was performed on the feature space to reduce its dimensionality. Finally, for classification, 97 PAS spectra (34 normal, 30 malignant, and 33 benign) recorded from 10 normal, 10 malignant, and 12 benign ovarian tissue samples were used. The performance evaluation of classification results were obtained by calculating statistical parameters like specificity, sensitivity, and accuracy, and they were found to be 100 %, 100 %, and 86.67 % respectively. For all of these investigations, pathologically certified normal, benign, and malignant samples were used. The goal of the present work is to explore whether photoacoustic spectroscopy could eventually be adapted to improve the early diagnosis of ovarian neoplasia.