

Spectral Bronchoscopy for Evaluation of Tissue Vascular Properties in Lung Cancer

M. Tercelj¹, T. Rott¹, D. Reinders², Y. Fawzy²

¹Clinical Center University of Ljubljana, Slovenia; ²Perceptronix Medical Inc Vancouver, Canada

Aim: To investigate if non-contact diffuse reflectance spectroscopy combined with modeling of tissue vascular properties could improve the accuracy of bronchoscopy for selecting biopsy sites.

Methods: A two-part study was conducted to create a library of spectra and matched biopsies. WL/FL bronchoscopy and spectra acquisition was performed using a special system (ClearVu Elite™) for acquiring spectral data during bronchoscopy. Bronchial passages were inspected and lesions were classified as visually suspicious or abnormal. A mathematical model was applied to each spectrum to estimate two tissue vascular properties: blood volume fraction and blood oxygen saturation level.

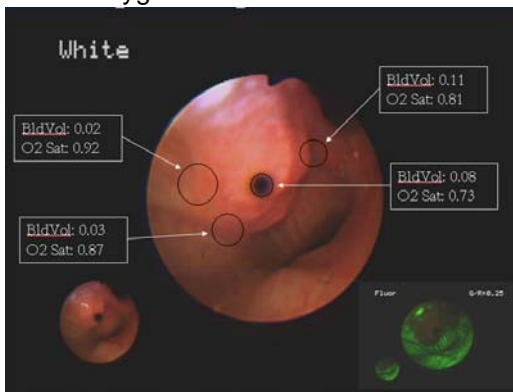
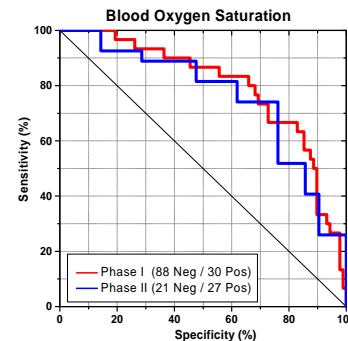
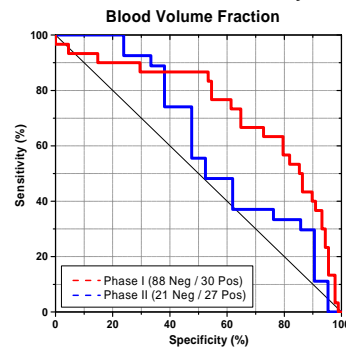


Figure 1 – White light image of a squamous carcinoma lesion illustrating model estimates of vascular parameters at multiple locations. Also shown is the corresponding fluorescence image.

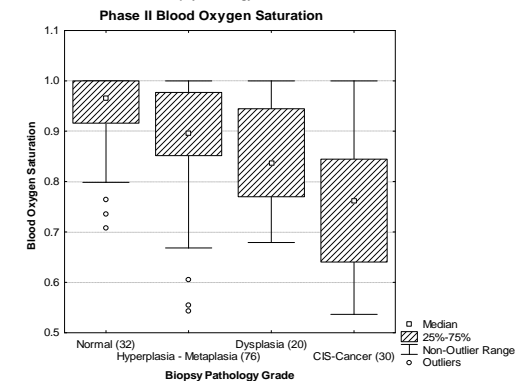
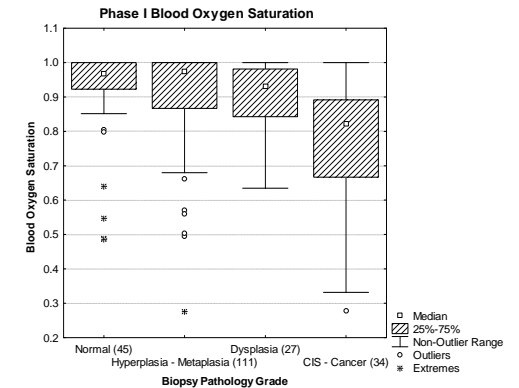
Results: A total of 56 CIS/Cancer lesions were identified from visually suspicious lesions, as well as 109 dysplasia or lower grades. The percent of visually suspicious lesions that were found to be CIS/cancer increased from 25% to 56% for the second study phase.

Phase	Subjects (N)	Total Biopsies (N)	Visually Suspicious Biopsies (N)
I	134	34 Positive	29 Positive
		183 Negative	88 Negative
II	108	30 Positive	27 Positive
		128 Negative	21 Negative

Both of the estimated vascular properties were shown to be useful for separating CIS/Cancer from lower grade lesions among visually suspicious sites (see ROC curves). However the blood volume fraction may be less discriminatory for Phase II data, while blood oxygen saturation performance appears essentially identical between phases. This may be because a high blood volume fraction is visible as “redness”, and so can be used in biopsy site selection, but blood oxygen saturation is not readily visible.



In total, estimated blood oxygen saturation was clearly decreased for CIS/cancer. However reduced levels were also observed for lower grades such as mild/moderate dysplasia, particularly for the second phase data.



Conclusions: Accuracy for visually identifying cancers while avoiding low grade or normal biopsies improved with experience. Additional discrimination may be possible using spectrally-estimated vascular properties. The benefit of spectral analysis may depend on whether an estimated tissue property is also visible in the image, since spectral results are not independent of the biopsy site selection criteria. The benefit may also therefore depend on operator experience with bronchoscopy.