TOTAL HEMOGLOBIN REDUCTION IN THE TUMOR VOLUME CORRELATES WITH RESPONSE TO BREAST CANCER NEOADJUVANT CHEMOTHERAPY WITHIN TWO WEEKS OF TREATMENT

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Optical imaging techniques have emerged as a possible alternative to predict pathological complete response (pCR) in breast cancer patients undergoing neoadjuvant chemotherapy (NAC). Our team developed a so-called diffuse optical tomographic breast imaging system (DOTBIS) which does not require the use of contrast agents or compression, and enables imaging of the whole breast volume using low intensity near infrared light capable to measure tissue concentration of oxy-hemoglobin (ctO2Hb), deoxy-hemoglobin (ctHHb) and water percentage. In this retrospective study, ctTHb changes in the tumor region of 16 breast cancer patients were analyzed across NAC. Both breasts of all patients have been scanned simultaneously with our DOTBIS system, Figure 1, which employs four wavelengths and gathers data from a total of 64 sources and 128 detectors per breast. A PDE-constrained multispectral image reconstruction code creates 3D image maps of total hemoglobin (ctHbT = ctO2Hb+ ctHHb). Tumor volume is selected by entering radiologic information such as tumor side, clock position and distance from the nipple (FN). An automated code was designed to select the highest value from the distance FN and the quadrant referent to the clock position. Subsequently, a region-based image segmentation method is implemented to examine neighboring pixels of the highest value point considering a mask of 90%. After tumor volume segmentation, we calculate the mean ctHbT extracted from the region of interest. An independent-samples t-test was run to determine if there were differences in ctTHb reduction in the tumor region before the third cycle of taxane between responders (n=4) and non-responders (n=12). ctTHb reduction was greater to pCR (45.71 ± 25.16 μM) than non-pCR tumors (-9.67 ± 25.65 μM), a statistically significant difference of 55.38 μM (95% CI, 23.74 to 87), t(14) = 3.755, p = .002, in Figure 2 we can see an example. From the ROC plot results, we can observe that ctTHb reduction in the tumor region after 2 cycles of Taxane is a good indicator to anticipate pCR status. With an area under the curve of 0.958, the best cut-off that maximizes sensitivity and specificity is 16.86μM. At this reduction level, the sensitivity is 100% and specificity is 91.7%. In conclusion, our findings indicate that DOTBIS-measured total hemoglobin in the tumor region may be a strong and independent predictor of treatment response to NAC.

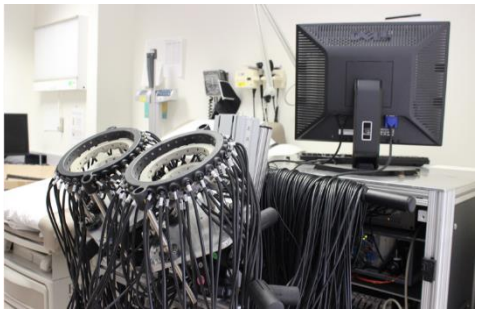

Figure 1 – Photograph of the custom-built diffuse optical tomographic breast imaging system (DOTBIS).

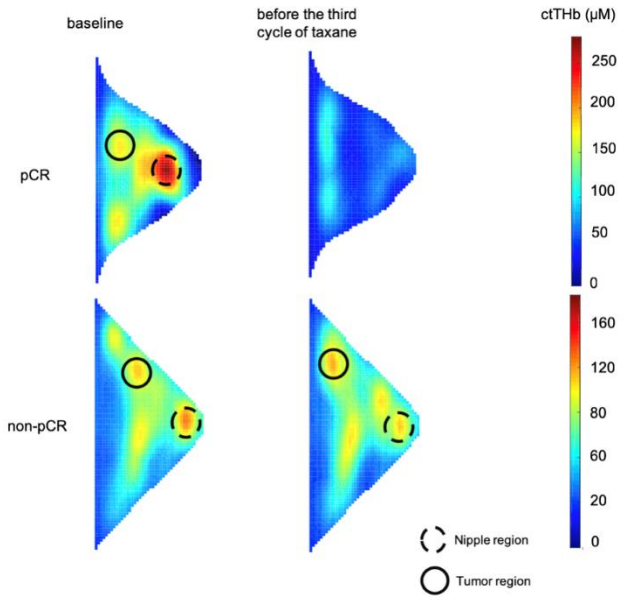

Figure 2 – Comparison between a pCR and non-pCR patient at baseline and before the third cycle of taxane. We see a significant reduction in ctTHb right after the second taxane drug cycle in the tumor region (filled circle line) for the pCR patient. Nipple region is identified by the dashed circle line.