

MULTISPECTRAL PHOTOACOUSTIC IMAGING CAN DETERMINE MALIGNANCY IN THYROID NODULES

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Background/Purpose: Thyroid nodules are common, however up to 20% of needle biopsies are nondiagnostic and some thyroids have numerous nodules making biopsy of each lesion impractical. We hypothesized that photoacoustic imaging (PAI), a novel imaging system that creates absorption maps by agitating tissue samples using laser energy and capturing the emitted ultrasound waves, could differentiate between benign, malignant, and normal thyroid tissue.

Methods: After review board approval, 50 consecutive patients who underwent thyroidectomy were consented and enrolled. Immediately following gross specimen processing, sections containing thyroid nodule(s) of interest were imaged using our multispectral PAI device at wavelengths corresponding to peak absorption of water (970 nm), lipid (930 nm), oxyhemoglobin (850 nm), and deoxyhemoglobin (760 nm). Constituent PA images were then created and co-registered with digital images of histopathologic slides. Mean intensity values (MIV), corresponding to the dominant optical absorption of each tissue constituent, were then determined for benign, malignant, and normal thyroid tissue. Student's T test was used for statistical analysis.

Results: Thirteen malignant thyroid nodules and 43 benign nodules were diagnosed on final histopathology. MIV for deoxyhemoglobin was higher in malignant tissue ($0.41 \pm .22$) than benign ($.26 \pm .14$) or normal ($.18 \pm .11$) tissues ($P=0.035$ and 0.003), reflecting higher tissue concentration of deoxyhemoglobin in thyroid cancer. Oxyhemoglobin, water, and lipid content appeared to be similar in benign, malignant, and normal thyroid tissues.

Discussion & Conclusion: Our results suggest that PAI can differentiate malignant from benign thyroid nodules based upon higher deoxyhemoglobin content in cancerous nodules. PAI is a promising diagnostic modality that warrants further investigation.