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Identifying Cancerous and Non-Cancerous Areas in Isolated Kidney Samples via Infrared Visualization

Figure 1. Experiment's setup

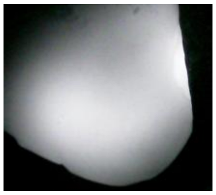

Figure 2. IR image of healthy kidney specimen

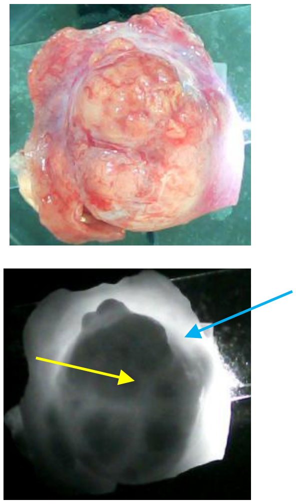

Figure 3. The upper image shows an excited kidney tumor alongside healthy tissue, while the lower image displays its infrared (IR) representation.

Objectives: The objective of this study was to create a novel technique for distinguishing between malignant and healthy areas in isolated kidney samples taken during surgery and determining the margins between the two types of tissue. This work is based on our earlier research, where differences in infrared images between tumors and non-cancerous tissue was studied.

Methods: We studied kidneys acquired post open radical nephrectomy. The specimens were positioned between the infrared light (IR) source and the CCD camera - Figure 1. We removed the malignant tissue from these kidneys along with some nearby healthy tissue. IR passing the kidney specimen contains information about the inhomogeneity of the tissue.

Our developed software highlighted areas associated with both malignant and healthy tissues, assessed their average brightness, and computed the ratio of the average brightness (RAB) of the malignant area to that of the healthy area and stored in the software's memory. After 32 operations the software calculated the interval for RABs with a 95% probability.

Results. The infrared image of the healthy part of the kidney shows consistent brightness throughout all areas of the image- Figure 2. The cancerous tissue, in contrast to the healthy tissue, shows a high degree of inhomogeneity and is significantly darker than the corresponding area of healthy tissue. Figure 3. The reason for this is that healthy tissue has a uniform optical density, while tumor tissue exhibits a highly non-homogeneous optical density. The IR imaging technology successfully distinguishes between areas of health and malignancy in the image, clearly defining their boundaries (figure 3). This finding was confirmed in all cases studied were validated by histo-morphological investigations. The software clearly distinguishes between healthy and malignant areas in an infrared image, setting the range for RABs at 0.38 to 0.42.

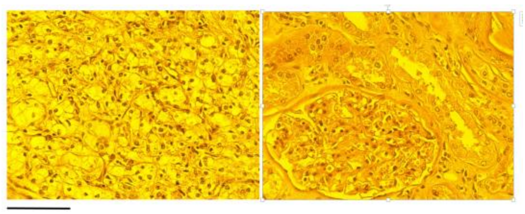

Figure 4 presents histomorphological images: the left image depicts cancerous tissue, while the right image shows healthy tissue. The left image corresponds to the yellow arrow in Figure 3, and the right image corresponds to the blue arrow in the same figure. x400. Caliber 100 micrometers

Conclusion: The proposed technique can be applied during partial nephrectomy and may assess margins at the nephrectomy site. It will drastically shorten the time of ischemia, enhance patient outcomes, and limit tissue damage.

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