Active thermodynamic contrast imaging for label-free tumor detection

Gyungseok Oh[1], Euiheon Chung[2]

Gwangju Institute of Science and Technology (GIST)
[1]**School of Mechanical Engineering and** [2]**Department of Biomedical Science and Engineering, Institute of Integrated Technology,**
123 Cheomdangwagi-ro, Gwangju 61005, South Korea
E-mail: ogong50@gist.ac.kr

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Conventional thermal imaging provides a limited differentiation between a tumor and neighboring tissue as the temperature differences are not always significant. Active infrared imaging has emerged to provide a novel physiological biomarker for early detection of a tumor without exogenous labeling. We developed an *active thermodynamic contrast imaging* (ATCI) approach with the hypothesis of differential physiological responses to thermal modulation between the tumor and normal tissues using heating and cooling modulations. We performed ATCI with convection thermal modulators to evaluate physiologically relevant parameters including the rate of temperature change and thermal recovery time with a mouse xenograft tumor model. With early-stage and established tumors, we found the average rate of temperature change was higher in the tumor than that of neighboring tissue. On the other hand, the thermal recovery time was shorter in tumor tissue than that of neighboring tissue with heating modulation. We also found distinct thermal contrast with cooling modulation. Our experimental data suggest the ATCI technique is a potential tumor detection modality for clinical application with its inherently label-free and physiology-based approach. From the histological analysis of tumor samples, we found some interesting evidences that may explain the observed differences in thermal responses. Furthermore, ATCI strategy may find applications in endoscopic tumor detection that is currently on-going.
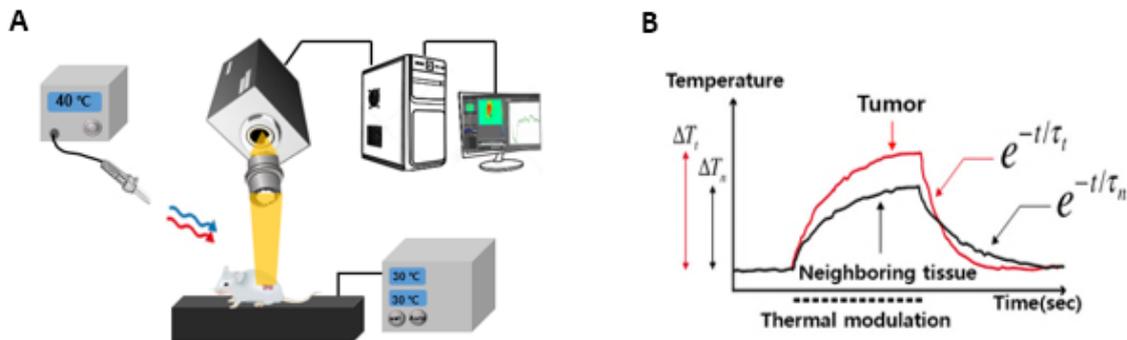
Figure 1. Experimental setup of active thermodynamic contrast imaging (A) and exemplary diagram for data analysis (B).

References

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