Technical University of Denmark

Popular science summary of the PhD thesis

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Title of the PhD thesis	Monitoring Cancer Response to Treatment with Hyperpolarized ^{13}C MRS
PhD school/Department	Electronics, Communication and Space/Department of Electrical Engineering

Science summary

* Please give a short popular abstract in either Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof:

Hyperpolarized Magnetic Resonance Spectroscopy (MRS) of ^{13}C molecules has recently emerged as powerful imaging modality that can monitor response to treatment in oncology, and thereby allow selection of proper therapy fast and effectively with great benefit to patients.

Conventionally, tumor response to treatment is often assessed by monitoring shrinkage of tumor size as indicated by X-ray Computed Tomography (CT) or Magnetic Resonances Imaging (MRI). However, these measurements do not give an early response in most cases. On the other hand, MRS of hyperpolarized ^{13}C substrates provides functional information about the tumor biology that should be affected early in the treatment cycle. If the therapy is not effective, the treatment can be changed, sparing the patient unnecessary side effects and improving the prognosis.

Two ^{13}C substrates were investigated in this project; [1-^{13}C]pyruvate, which is used to probe the metabolism, and [1,4-$^{13}C_2$]fumarate, which is used to detect necrosis. We showed that the conversion of hyperpolarized [1-^{13}C]pyruvate into [1-^{13}C]lactate can effectively indicate the response to treatment in two types of non-small-cell lung cancer, and that the performance of [1-^{13}C]pyruvate marker is comparable to the Positron Emission Tomography marker fludeoxyglucose (FDG), which is widely used in functional imaging of cancer. We also showed that the conversion of hyperpolarized [1,4-$^{13}C_2$]fumarate into [1,4-$^{13}C^2$]malate is a useful tool to image necrosis *in vivo.* This finding was demonstrated in rat kidneys after ischemia/reperfusion and in rat muscles after turpentine injection.

The project also aimed to improve existing ^{13}C MRS methods to efficiently utilize the signal from hyperpolarized ^{13}C substrates. A sequence was developed that allowed higher spatial and temporal resolutions compared to the existing method.

Please email the abstract to the PhD secretary at the department