

# Study of real time $^{13}\text{C}$ metabolic fluxes using Dynamic Nuclear Polarization and Magnetic Resonance Spectroscopy

*Commonly used acronym: DNP*

*Created on: 23-09-2019 - Last modified on: 08-11-2019*

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## Organisation

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**Country** Belgium

**Geographical Area** Brussels Region

## SCOPE OF THE METHOD

<b>The Method relates to</b>	Animal health
<b>The Method is situated in</b>	Basic Research, Translational - Applied Research
<b>Type of method</b>	Other: In vitro and in vivo method

## DESCRIPTION

### Method keywords

hyperpolarization

$^{13}\text{C}$  metabolic fluxes

$^{13}\text{C}$ -MRS

in vitro and in vivo tool

### **Scientific area keywords**

tumor metabolism

cardiac function

metabolic disorders

<sup>13</sup>C metabolism

### **Method description**

Hyper Polarized (HP) MR allows to considerably increase the sensitivity (>10.000) of MR spectroscopy and spectroscopic imaging. The hyperpolarized molecule can be injected at room temperature to a cell system or an *in vivo* model and its metabolism can be followed over a few minutes. The technique has been used *in vivo* or *in vitro* to assess changes in metabolic fluxes through glycolysis, citric acid cycle, and fatty acid synthesis. HP MR studies using <sup>13</sup>C pyruvate showed an increase in signal to noise ratio of more than 50.000 of the substrate and its metabolites (lactate and alanine), allowing for unique dynamic mapping of metabolism using spectroscopic imaging.

### **Lab equipment**

The oxford instruments HyperSense DNP system is combined with our 11.7T preclinical Magnetic Resonance system (Bruker Biospin) for *in vivo* application or with our Bruker Ascend 600MHz NMR system for *in vitro* application. The Hypersense allows hyperpolarization of <sup>13</sup>C-enriched substrates, direct dissolution and cooling down of the substrates and allows consecutive injection in the vascular system of the animal under study or in cell media for *in vitro* application.

### **Method status**

Published in peer reviewed journal

## **PROS, CONS & FUTURE POTENTIAL**

### **Advantages**

The method allows the assessment of real-time metabolic conversion (i.e. of <sup>13</sup>C-pyruvate into <sup>13</sup>C-lactate) with high sensitivity and non-invasively (while used *in vivo*). It constitutes a key tool to address fundamental questions in the scope of

metabolism in several fields, including oncology, cardiology, metabolic disorders, etc...

## Challenges

A major limitation of DNP is a requirement of a long relaxation time  $T_1$  for the  $^{13}\text{C}$  enriched substrate. The useful monitoring time is limited to  $5X T_1$ , which includes dissolution, injection, and imaging. Hence, for pyruvate, there is a maximum of 3 min of useful measuring time. Nevertheless, the technique has already shown numerous applications for detecting treatment response in animals.

## Modifications

No modifications are planned in the near future.

## Future & Other applications

Metabolic disorders ;  
Cardiac function metabolism ;  
Cancer metabolism.

## REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION

### References

Magnetic resonance imaging of cancer metabolism with hyperpolarized  $^{13}\text{C}$ -labeled cell metabolites. Hesketh RL, Brindle KM. *Curr Opin Chem Biol.* 2018 Aug;45:187-194. doi: 10.1016/j.cbpa.2018.03.004. Epub 2018 Jul 13.

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