[1-^{13}C]lactate signal derived from hyperpolarized [1-^{13}C]pyruvate originates from the brain, not from the blood.

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Introduction

Injection of hyperpolarized [1-^{13}C]pyruvate and detection of metabolic products such as [1-^{13}C]lactate is a promising new technique for the study of metabolism *in vivo* in healthy and pathologic conditions, such as tumors [1]. Recently, we have shown detection of [1-^{13}C]lactate in the normal brain *in vivo* after injection of hyperpolarized [1-^{13}C]pyruvate [2]. However, the spatial origin of the detected signals has been of a matter of debate. In the present work, we sought to demonstrate that the lactate signal observed in the brain originates essentially from the tissue metabolism. To that aim, we used a coil specifically designed to detect ^{13}C resonances in the carotid of anesthetized, living rats receiving an injection of hyperpolarized [1-^{13}C]pyruvate.

Methods

A carotid coil was designed according to Zhang *et al.* [3]. All experiments were conducted using a 9.4 T horizontal bore magnet equipped with Varian INOVA console. Two adult male Sprague-Dawley rats were anesthetized using isoflurane. They were intubated and femoral arteries and vein were cannulated for monitoring of blood gases and blood pressure, and for injection of hyperpolarized pyruvate. The neck coil (1 cm long, 2 mm diameter) was wrapped around the carotid while the flow was visually monitored for regular beating. Following surgery, the animal was positioned in the magnet, and physiology was monitored throughout the experiment. A brain coil was also positioned on the head of the animal to measure spectra from the brain. A pulse acquire sequence (TR=0.75 s) was used to acquire the signal from either the carotid or the brain after two separate injections.

Results and conclusion

Figure 1 illustrates the results obtained *in vivo*. After injection of hyperpolarized [1-^{13}C]pyruvate, signals from pyruvate and pyruvate hydrate were observed in the carotid and in the brain. Lactate, in contrast, was detected only when using the brain coil, and was not detected when using the carotid coil. This suggests that the lactate signal detected in the brain *in vivo* originates primarily from tissue metabolism and not from blood.

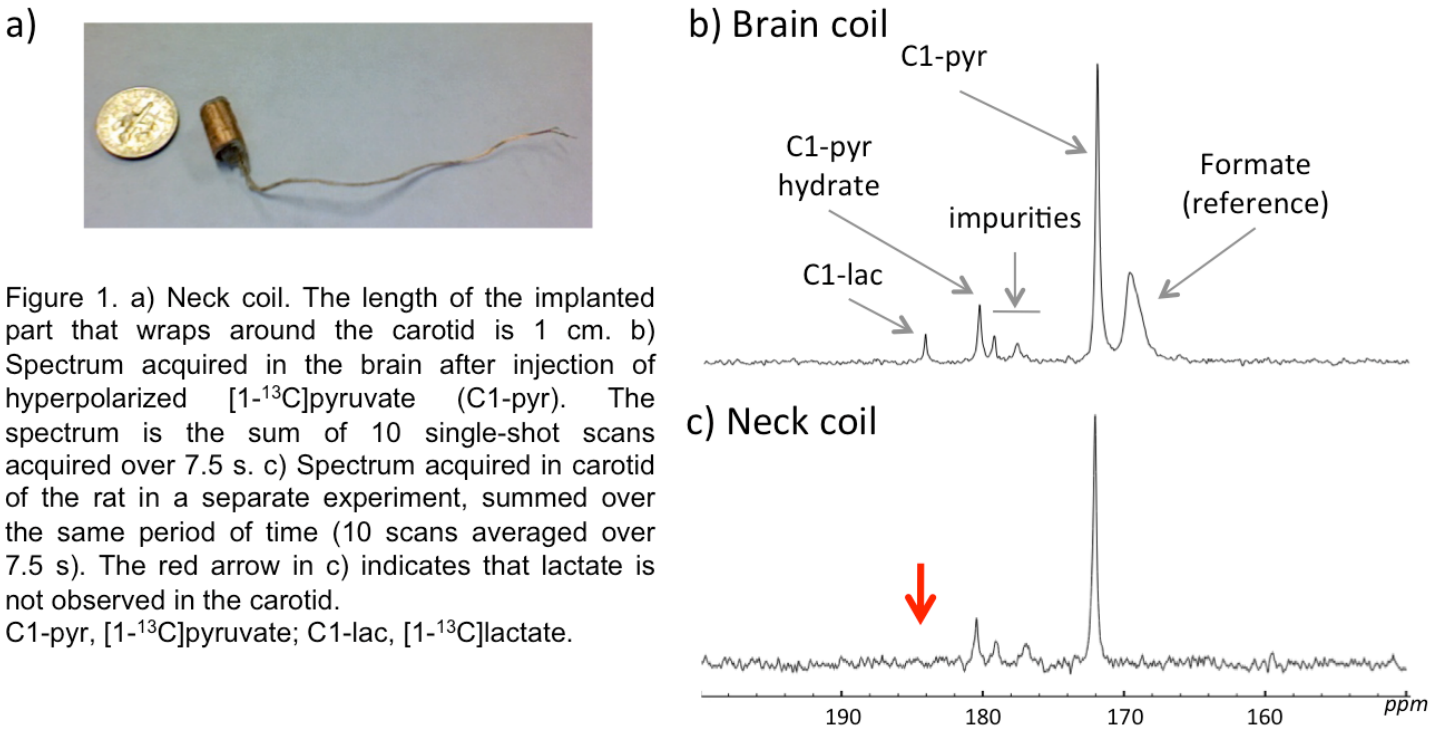

Figure 1. a) Neck coil. The length of the implanted part that wraps around the carotid is 1 cm. b) Spectrum acquired in the brain after injection of hyperpolarized [1-^{13}C]pyruvate (C1-pyr). The spectrum is the sum of 10 single-shot scans acquired over 7.5 s. c) Spectrum acquired in carotid of the rat in a separate experiment, summed over the same period of time (10 scans averaged over 7.5 s). The red arrow in c) indicates that lactate is not observed in the carotid.
C1-pyr, [1-^{13}C]pyruvate; C1-lac, [1-^{13}C]lactate.

References: 1. Day, S.E., *et al.*, Nat Med, 2007. 13(11): p. 1382-7. **2.** Marjanska, M., *et al.* in ISMRM Proc. 2009. Hawai'i. **3.** Zhang, X., *et al.*, MAGMA, 2003. 16(2): p. 77-85. **Acknowledgements.** The authors thank BTRR P41RR008079, NCC P30NS057091, R01NS038672 and the KECK Foundation.