The ^{17}O imaging for regional oxygen consumption rate in tumor bearing mice at 7T

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Introduction

The tissue oxygenation status depends on the oxygen supply and consumption. The oxygenation status in tumor is a very important factor for the effective treatment and the progression[1]. Recently, ^{17}O imaging for metabolically generated $H_2{}^{17}O$ from inhaled $^{17}O_2$ has been shown to be useful for $CMRO_2$ measurement [2-4]. To obtain the regional oxygen consumption rate in the tumor, we have developed ^{17}O imaging by FISP and succeeded in mapping the distribution of injected $H_2{}^{17}O$ in mice with a temporal resolution of 10 sec[5]. In this study, the oxygen consumption rate after $^{17}O_2$ gas inhalation was evaluated by the ^{17}O imaging in the tumor bearing mice.

Methods

MRS/MRI was performed on Biospec 70/20 USR (Bruker) with 40 mm $^1H/^{17}O$ Litz coil (Doty Scientific Inc.). The colon 26 adenocarcinoma cells ($1*10^6$ cells) were s.c. inoculated into the right shoulder of BALB/cA mice (22-25 g). The tumor (ca. 0.5~1.0 mm^3) bearing mice were anesthetized by i.p. injection of chloral hydrate anesthesia (400mg/kg). The oxygen gas enriched to 50% ^{17}O (ISOTEC) was supplied to the mask attached to the mouse head at the rate of 50 mL/min for 2 minutes. ^{17}O images of the mice were obtained every 20 seconds during the $^{17}O_2$ inhalation and following 13 min by true FISP with TR/TE = 4.3/2.15 ms or 3/1.5 ms. After the imaging experiment, organs were excised for ^{17}O spectral quantification. Water and saline phantoms, ranging 2 to 26 g, were used for the calibration of ^{17}O spectral and image intensities for quantification.

Results & Discussion

The inhalation of $^{17}O_2$ gas raised the signal intensity in ^{17}O images within the experimental time scale. Fig.1 shows the coronal FISP ^{17}O-Images of a tumor bearing mouse acquired by 5 min data acquisition before and 25 min after the inhalation of $^{17}O_2$ gas. The increase in the signal intensity was 1.26 and 1.33 times of baseline in brain and tumor, respectively: $H_2{}^{17}O$ production from inhaled $^{17}O_2$ could be followed up by ^{17}O images. The increment of summed ^{17}O image intensities was in good agreement with that of whole body spectra, which confirmed the image of this work quantitative. The quantity of $H_2{}^{17}O$ produced in the tumor was in the range of the value expected from the literature[6].

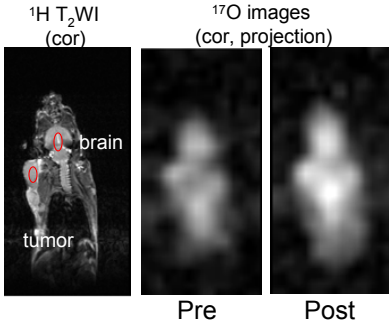

Fig.1 ^{17}O images of tumor bearing mouse obtained by 5 min data acquisition before and after 2min-50% $^{17}O_2$ inhalation.

Conclusion

^{17}O imaging of water is qualified as a powerful tool for regional oxygen consumption rate.

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