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Live Mice imaging with a 14.1T narrow-bore NMR magnet heading for *fMRI* by using an independent digital console and gradient probe

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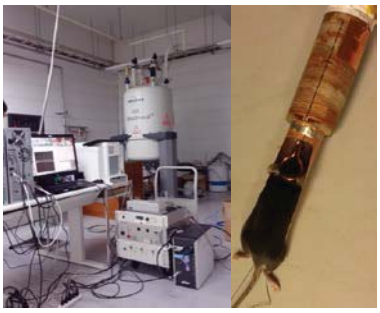
Introduction

A mouse disease model in biomedical sciences is the global standard. In order to make use of MR imaging for the mice models of such as skin-tumor, liver, kidney, or the other big tissues, a compact permanent magnet MRI system(1) is a promising modality which shall be joined into their measurement series. However, are the very limited numbers of ultra-high filed MRI (> 7T, > wide bore 89 mmϕ) for mice able to support surely expanding demand for transgenic mouse models of e.g. brain sciences? In order to meet this demand, we have further developed a simple MRMICS (2) method to utilize, standard narrow-bore NMR vertical-magnets, of which are 9,100 (3) installed NMR systems in the world-wide, to be a mouse brain's MR scanner part-timely and reproducibly.

An independent mouse MRI system and experiment

Figure 1(a) shows a developed mouse MRI system with an existing 14.1T NMR magnet. The digital MRI console (4) has a PC (win7), digital transceiver (FPGA, rf converter & switch), rf transmitter (50W), gradient driver (+/-20V/20A). The probe head shown in fig. 1(b) has a three-axis gradient coil (ID/OD= 23/33 mmϕ, 40 mT/m/A) and surface rf coil (15 mmϕ). In order to investigate the imaging capability and BOLD (5), C57BL/c (M, 3-6W) were imaged under injection-anesthetization by α-chloralose or Ketamine. Oxygen was supplied to the mice's atmosphere in flow rate from 0 to 500 mL/minute. These experiments kept animal's experimental regulation of the university department.

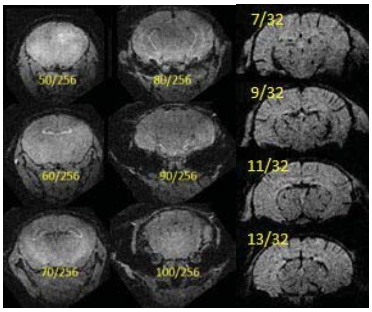


(a) (b)

Fig. 1: 14.1T mouse MRI system.

Result and discussion

Figure 2(a, b) shows the imaging result (T_{acq}=15min, T_{aqw}=5.12ms,) of mice (C57BL/c); (a) 3W, 3D-GRE, 1024x128^2, TR/TE/FA = 60/6ms/90deg, (110μm)^3 : (b) 6W with suppressed oxygen flow, 3D-GRE, 256x128x32, TR/TE/FA = 100/6.5ms/90 deg, 110x110x200 μm^3. Fig.2 (a) has brighter signal intensity than that of (b), which has black lines on their cerebral cortex indicating blood oxygenation level dependency (BOLD).



(a) (b)

Fig. 2: 3D-GRE images at 14.1T indicating BOLD effect.

Conclusion

The live mice were imaged with the existing ^{1}H-600MHz NMR magnet and the developed MRI unit with the digital console and probe head with using 3D-GRE sequences. The NMR magnet had enough B_0-homogeneity and the result promised mouse's *fMRI* with BOLD effect. This approach utilizing an existing NMR magnet with using the independent MRI unit is confirmed to be used as a mouse MR scanner at biomedical laboratories especially in brain and neuroscience.

References:

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