Specific Pathogen-Free Transgenic Mice Carrier for Molecular MR Imaging

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PURPOSE:

Since transgenic mice often have compromised immune systems, they are stored in barrier specific pathogen-free (SPF) facilities. These facilities have the highest level of pathogen protection available and are essential to the integrity of transgenic research. If a transgenic mouse is removed from the barrier SPF facility and exposed to any potential external pathogens, it cannot be returned to the barrier SPF environment, putting the animal at risk during future housing. This dilemma is particularly acute for longitudinal imaging studies, where the same subject is used for repeated imaging sessions. In addition, the cost of transgenic subjects makes longitudinal imaging studies more attractive. In this study, we developed a device that will maintain a SPF environment while allowing for the longitudinal MR scanning of transgenic mice.

MATERIALS AND METHODS:

The device consists of an air-tight mouse cage with a special cradle attachment to hold the transgenic mouse within a custom-built MRI coil. It allows for prolonged anesthesia through filtered gas lines as well as the injection of MRI contrast agents inside the cage, which can be done using gloveports to manipulate the animal. To allow for reentry of transgenic mice to barrier SPF facilities, all materials used to build the device are autoclavable. To demonstrate the capability of our design to enable MRI imaging while maintaining the SPF environment, a 16 month old mouse was anesthetized (ketamine/xylazine) and placed in the cradle attachment within the custom-built coil, which allowed for a reproducible positioning of the body. A T1-weighted scan (3D SPGR, TE=6.8 ms, TR=15 ms, FA=14°) was then performed (8 min) on a 1.5T scanner (Signa, GE, Milwaukee, WI). Transaxial slices from the cerebellum to the hind legs were reconstructed using fully automated software (NEUROSTAT, University of Washington).

RESULTS:

Pictures of the complete device design and the mouse in the scanning attachment showing how the gloveports can be used to inject contrast agents are shown in Fig. 1. Images from the test scan of the mouse's cerebellum, heart and lungs, and abodominal area are shown in Fig 2.

Figure 1. 3D Solidworks model of device (left), a demonstration of injection of mouse tail in the scanning attachment (middle) and the mouse in the coil and scanning attachment (right).

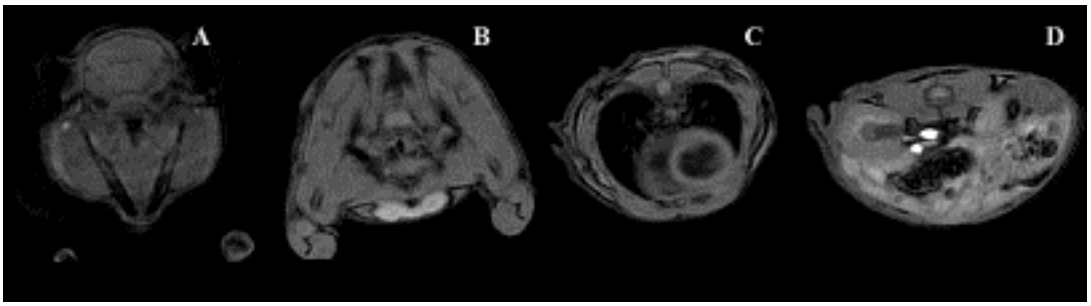

Figure 2. T1-weighted MR images of the (A) cerebellum; (B) beginning of spinal column; (C) lungs and heart; and (D) abdominal area with stomach and liver.

SUMMARY AND CONCLUSIONS:

This study demonstrates the design and use in MRI imaging of a transgenic mouse carrier, including a custom-built coil, for longitudinal imaging studies to maintain barrier SPF conditions. This device will reduce the number of expensive transgenic subjects required for an imaging study and maintains a controlled environment over the course of the study.