

SOP: Animal scanning general procedures: anesthetized animals (August 2012)

Responsible personnel: Dr Axel Mathieu (Douglas Institute CIC)

1. Anaesthesia:

Mice and rats are anesthetized by induction with a 5% isoflurane/oxygen mixture for a maximum of 5 minutes in a species-appropriate induction chamber. The animals are then placed on the MRI animal bed and inserted within the MRI where they are maintained with an isoflurane/oxygen mixture of 1-2% using an integrated nose cone with tooth bar. Depending on the type of scan to be acquired, the anesthesia lasts between 1-4 hours. Body temperature during scanning is maintained by using a warm air flow over the animal that is set at 29°C. In order to measure the respiration rate and monitor the depth of anesthesia throughout the procedure, the animal is placed on top of a respiration pillow and maintained in position using Velcro straps not directly in contact with the animal (additional thin foam pads are used to secure the animal). For brain scans, depth of anaesthesia is maintained at 30-70 breaths per minute. For peripheral scans (abdomen for instance), depth of anaesthesia is maintained at 25-45 breaths per minute. It is also possible to monitor the animal's heart rate at the Researcher's request. Altogether, the setup time to prepare the animal for scanning is approximately 15-20 minutes. Once the scanning is completed, the animal is given a s.c. injection of 0.9% NaCl (1 mL/hour of anesthesia for rats, 0.25 mL/hour of anesthesia for mice) if the scanning time was over a 2hr period. Animals are returned to their home cage in the regular housing room. For animals originating from outside the Douglas animal facility, they are held in a quarantine-type of room in the CIC and returned to this room after scanning.

Depending on the scanning time and procedure performed in the scanner, the animal will be allowed to rest for 2-3 days prior to additional scans being performed on the same animal.

2. MRI Instrumentation:

MRI images are obtained with a horizontal Bruker Biospec 70/30 USR (7 Tesla) equipped with either a 198/114 mm gradient insert capable of 660 mT/m maximum strength and a maximum slew rate of 4570 T/m/s or a 301/200 mm gradient insert capable of 300 mT/m maximum strength and a maximum slew rate of 1080 T/m/s. Measurements are performed with a 112/72 mm circularly polarized resonator alone or in combination with one of the following dedicated receive only ¹H head surface coils: mouse brain quadrature, mouse brain phased array, rat brain quadrature, or rat brain phased array.

Mice Brain Anatomical scans: 3D whole mice brain images are obtained using the standard Bruker TrueFISP pulse sequence with eight different phase advance ($\Delta\Phi$) parameters resulting in eight images. The final image is the root mean square of these 8 images for a total scan time under 30 minutes. Parameters: FOV: 1.8 x 1.8 x 0.9 cm; Matrix: 128 x 128 x 64 points; Resolution: 140 x 140 x 140 μ m; TE/TR: 2.6/5.2 ms; Flip Angle 20-40°; Bandwidth: 50kHz; Phase Advance Array: 180°, 0°, 90°, 270°, 45°, 225°, 135°, 315°; Averages: 2; Acquisition Time: 3.5 minutes for each phase advance.

Mice Abdomen Anatomical scans: 3D mice abdomen images are obtained using the standard Bruker TrueFISP pulse sequence with five different phase advance parameters resulting in five images. The final image is the root mean square of these images for a total scan time under 30 minutes. Parameters: FOV: 2.56 x 2.56 x 1.92 cm; Matrix: 128 x 128 x 96 points; Resolution: 200 x 200 x 200 μ m; TE/TR: 2.6/5.2 ms; Flip Angle 20-40°; Bandwidth: 50kHz; Phase Advance Array: 180°, 0°, 90°, 45°, 135°; Averages: 2; Acquisition Time: 5.2 minutes for each phase advance.

Rat Brain Anatomical scans: 2D whole rat brain images are obtained using the standard Bruker RARE-T1 pulse sequence. Parameters: FOV: 3.2 x 3.2; Matrix: 256 x 256 points; Resolution: 125 x 125 x 800 (slice) μm ; TE_{eff}/TR : 9/2000 ms; Bandwidth: 70kHz; Averages: 4; Acquisition Time: 6.5 min for each phase advance.

Rat Brain fMRI: 2D whole rat brain images for fMRI are obtained using the standard Bruker Spin Echo EPI pulse sequence. Parameters: FOV: 3.2 x 3.2; Matrix: 64 x 64 points; Resolution: 500 x 500 x 800 (slice) μm ; TE_{eff}/TR : 12/2000 ms; Bandwidth: 250kHz; Averages: 1; Repetitions: 150; Total acquisition time: 5 min for each phase advance.

3. Reduction of Potential Cross-Contamination from Animals to be Scanned from Outside the Douglas Institute Animal Care Facility:

Several measures have been implemented and are ready for operation for the scanning of animals from other sources than the Douglas Institute Animal Care Facility (offsite animals).

- i) Offsite animals are to be processed as per the usual Animal Care Facility procedures PRIOR arrival at the Brain Imaging Center/Animal Care Facility.
- ii) The procedures room GH-1205 is to be reserved alongside the animal MRI on the BIC Reservation Website to restrict internal use of this room when offsite animals are to be manipulated.
- iii) Experiments should be scheduled to avoid contact between animals from different facilities or between animals from normal and quarantine housing rooms
- iv) All equipment and areas exposed to the offsite animals are to be thoroughly washed with Peroxyguard made available onsite, before and after use.
- v) Disposable liners are to be used within the anaesthesia induction box; this can be an appropriately sized cardboard box or plastic bag.
- vi) For scanning, offsite animals are to be placed in plastic bags with an opening large enough for the animal to breath or maintain anesthesia if required.
- vii) Separate color-coded washable custom made parts have been dedicated and made available for offsite animal scanning. These include special pads for placing the animal in the scanner, additional tooth bar tips and attachment material. This equipment has also been placed in sealed plastic containers; two separate color-coded kits have been made.