

LAB_034 Use of Air Heating System for 9.4T MRI

I. OBJECTIVE

To support animal physiology during MRI imaging of live mice in the 9.4T MRI unit.

II. COMMENTS / RECOMMENDATIONS

At the Centre for Advanced Imaging (CAI) this procedure must be performed by a CAI approved experienced operator or the operator must have completed an induction and training by Facility Manager or approved operator.

The new air heater system (SAII) at 9.4T MRI is a close-loop feedback control system that automatically operates to maintain animal temperature. It requires four key components:

1. the heating system (heater, fan module and green tubing) (Fig.1)
2. rectal temperature probe, and
3. proper software setting in the PCSAM (Fig 2).
4. a secondary fail-safe external hot air monitor, this will alarm at 50°C (Fig 3)

Air Heater blows either heated or room air to heat up or cool down the animal based on the difference between the **set temperature** and actual temperature reading from the **rectal temperature probe**.

Warning!!

1. **Failure or improper setup of either one component would lead to malfunction of the system and results in overheating/cooling of animal.**
2. **Directly heating animal with the hot and dry air could affect the animal physiology.**

Eye lubrication – non-medicated ophthalmic lubricant (e.g. Visco-tears© gel) should be applied aseptically to both eyes prior to the commencement of imaging.

Fluid support – administering normal saline subcutaneously (SC), via a 0.5mL bolus, prior to the commencement of imaging should be performed. This will assist to maintain stable anaesthesia and patient recovery. If a constant rate infusion (CRI) of anaesthetic is being used, that is expected to deliver a similar volume of isotonic fluids, a SC bolus may not be required.

Conditions:

- Investigators named in an animal ethics application, relative to this SOP, must be competent to implement the SOP
- Any variation to this SOP must be described in the relevant animal ethics application
- If this SOP has not been reviewed and approved by a UQ AEC within the last three years it is no longer valid and cannot be used in animal ethics applications until reapproved (see "AEC Reviewed/Approved" date in this document's header).

III. PROCEDURE

1. Before getting the animal, connect and test all the 3 components are working properly:
 - a. Tape the temperature probe at where the mouse would be on the animal holder and secure the heating tube about 10 cm behind the rectal probe. (Fig.1, A)

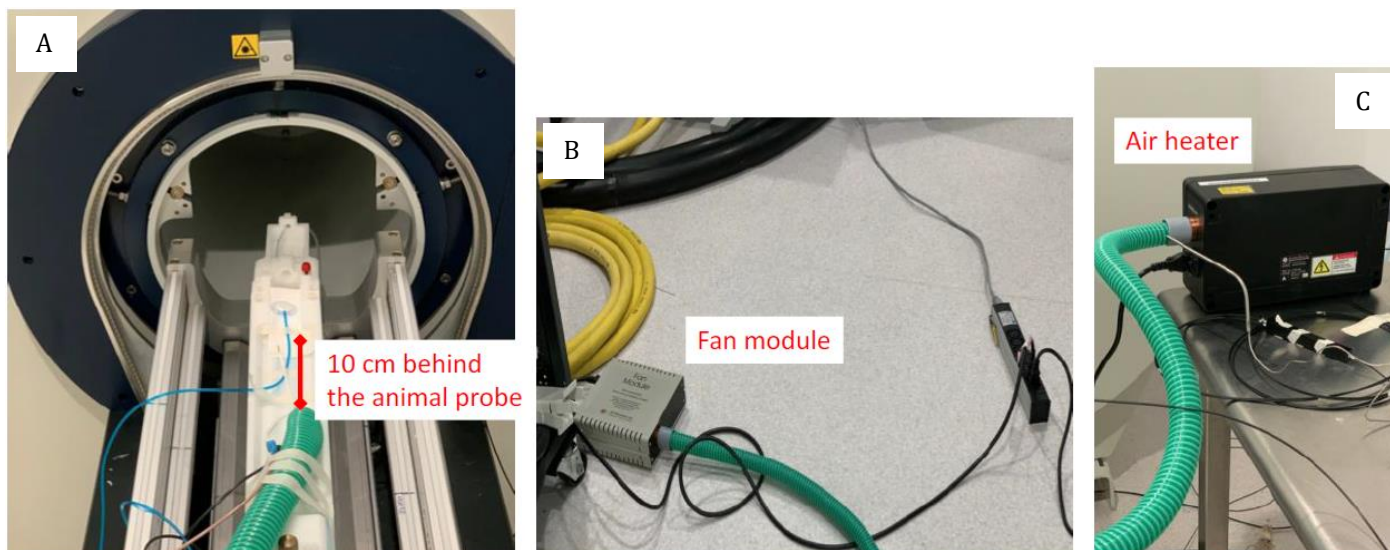


Fig. 1

- b. Turn on the laptop and PCSAM software. At the bottom of the monitoring screen, there is a button "Heater". Click to open the setting. Make sure the heater setting is temperature = 36.5°C and duty cycle = 37%.

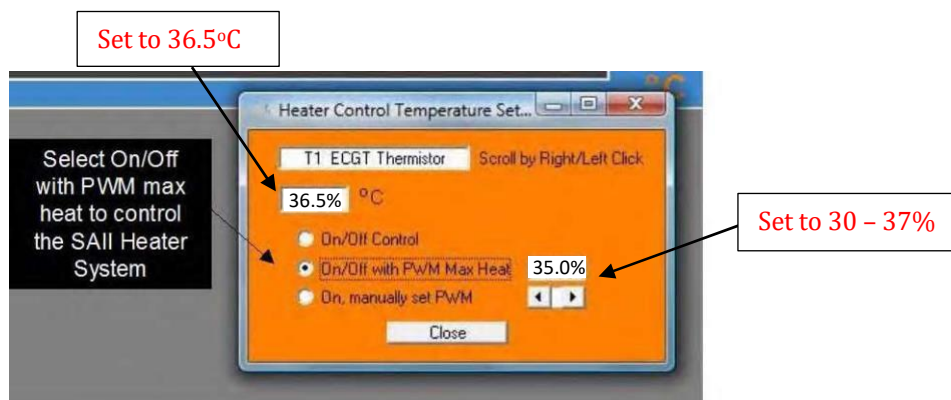


Fig. 2

- c. Connect the secondary hot air monitor to USB power (Fig 3). The secondary probe will need to be placed at the air outlet, behind the mouse rear.

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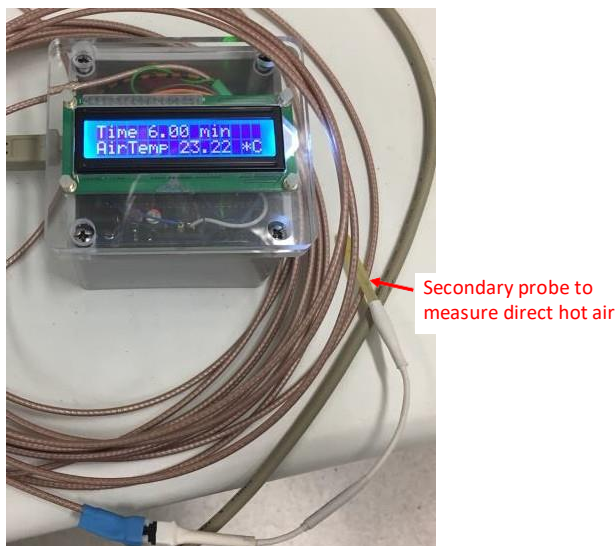


Fig. 3

- d. Turn on the heater and fan module (Fig.2).
NOTE: fan module is not MRI compatible so should be kept away from the magnet.
 - e. Check the hot air coming from the heating tube using the secondary probe (Fig. 3). - If the hot air goes up to 50°C then the system is working fine. **If it goes over 50°C then it is too hot and the monitor should beep. The heating element duty cycle will need to be reduced to 30-35%.** If the temperature does not increase, check whether the heating light is blinking in the back of heater (Fig.3). If not, check all connections and power switches.
 - f. Check whether the rectal temperature probe detects increased temperature. **NOTE: air heater duty cycle should NOT go >50%.** This is critical to avoid overheating of animal. Overheating could also damage the heating tube and surrounding MRI equipment.
2. Prepare two paper towels for making blankets of 2 sizes.
Fold one paper towel 3 times to make a small blanket of 8 layers. (Fig. 4. left)
Fold the second towel 2 times to make a big blanket of 4 layers. (Fig. 4. right)

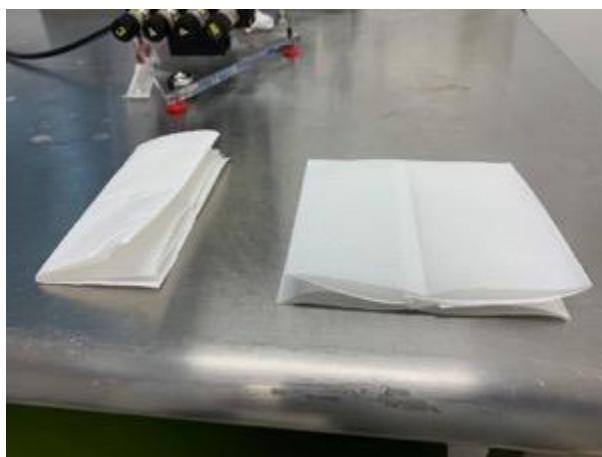


Fig. 4

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3. Prepare the animal according to your protocol.
4. After putting animal onto the holder, ensure rectal temperature probe is properly inserted into animal and secured (eg, taped together with the tail or taped on the holder).



Fig. 5



Fig. 6



Fig. 7

5. Use the small blanket to cover the body of the animal, including the tail. Tape it loosely on the holder so it does not press on the animal. (Fig.5)
6. Position and secure the heating air tube at the back of the animal, about 5 cm away. Make sure it does not pressure on any part of the body (eg, tail or legs).
7. Put the big paper blanket on top of the small blanket and the heating tube to cover them up. (Fig. 6)
8. Tape around the 2nd paper towel to create an “air pocket” for keeping the hot air inside (Fig. 7). **Make sure the front is sealed and no leaking.** This way keeps the hot air over the body while preventing the hot air directly blowing on any body part and avoid drying up nose and eyes.

NOTE: Remember NOT to make this paper flatten over the body, otherwise there won't be space for hot air to go in. Also, be careful NOT to have excess tissue on the side of the holder, otherwise it may get stuck and removed when moving into the bore.

9. After the experiment has finished, remember to **TURN OFF THE HEATER AND FAN MODULE.** Otherwise the heater will continue to run and lead to damage to the heater.

CAUTION and TROUBLESHOOTING

- 1) Be careful when pushing the holder into the scanner, the heating tube may become dislodged if not appropriately secured using adhesive tape.
- 2) The air heater can generally quickly and automatically maintain the temperature precisely at the set temperature with variation only ~0.2 degree.
- 3) Monitor the animal temperature constantly. If the temperature deviation from the set temperature too much, it may be 1) that the temperature probe has become loose, or 2) the “air pocket” is leaking. If this happens, take out the holder and check again.

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