Chapter 4

The Animal in Animal Imaging

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1. Introduction

With the development of new imaging modalities, techniques, and radiotracers, it is easy to get caught up in the excitement of the equipment and the pictures. Yet the value in imaging lies primarily in the benefit it brings to human lives. That potential value is determined first by studies in animals. This paper will focus on the care and handling of rodents as they make up over 90% of the animal research done. However, many of the concepts we will be discussing could be applied to any species. Whatever species you work with, take time to learn about them and their specific needs; it will pay compounding dividends.

Although you may be more aware of a multi-thousand dollar transgenic, I also want to impart the importance of monitoring even the two-dollar “garden-variety” mouse. The cost of buying the animal is only a small part of your overall expense. You can calculate other numbers such as lost technician time, wasted radiotracers, lost machine time, and your time (which is becoming an increasingly precious commodity). More importantly, how do you calculate the effect of poor data gathered from an animal that may have outwardly appeared fine, but whose physiological parameters were far from “normal”? I recall a graduate student who was seriously impacted by the discovery that a particular physiological function they had studied for two years was due to a one-degree temperature change that occurred while the animal was under anesthesia. Heart rate, respiratory rate, and body temperature are all affected by anesthetics and sedatives; these, in turn, affect cardiac output, acid-base balance, and perfusion of all the tissues. Poor perfusion or an acid-base imbalance affects uptake and washout of the radiotracer and drugs given. “Physiological stability also impacts on interstudy variability as well as intrastudy variability” [Qiu, 1997]. The more we know about what is happening, the more we can strive for a more physiologically normal parameter, and the more applicable our findings are. Before leaving this topic, I will mention the most important reason for careful monitoring of each animal because I feel it serves as a compliment to the fine researchers I have had the opportunity to work with over the past 20 years: we

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are given stewardship over the species that we work with; they are to be valued for
the contribution they make to our lives and are to be cared for responsibly and with
compassion. As I often tell the students who I am working with, “If you don’t feel
anything for the animal you are working with, it’s time to change professions.”

2. Health surveillance programs

Monitoring of the animal in research begins even before it arrives at your institu-
tion. Vendors and institutions have a variety of health surveillance programs
to identify infectious organisms. At the University of Arizona, vendors are placed
on an approved list when they meet or exceed the guidelines used here. Animals
coming from these vendors can enter into use within a few days after arrival. (There
is an adjustment period of at least two days, and preferably five days, after arrival to
allow the animal to recover from the stress of shipment and adjust to a new location.
If animals are placed into an experiment before their stress responses have returned
to normal, physiological responses will be altered.) However, it is not unusual that
animals coming to our facility for imaging have spent time at another facility with a
differing set of guidelines. More and more mice are originating from noncommer-
cial sources with the development of unique genetically altered models. In some
of these situations, the health status is unknown. “Although most rodent infections
may not cause clinical signs, such infectious agents can still alter physiological
parameters and influence experimental results, thus increasing the number of an-
imals needed to compensate for statistical variability and avoid misinterpretation
of the data” [Martin-Caballero, 2002]. Subclinical infections, such as the mouse
parvovirus, may not be an issue to one investigator’s study, but could significantly
impact other research such as involving the immune system. Your imaging system
may serve as an ongoing source of infection once infected animals are placed within
it. Rat pinworms have plagued many facilities and these relatively sticky eggs are
frequently spread on fomites. Once introduced to your facility, you can expect
weeks of treatment and disinfection causing serious delays to your research and the
addition of new variables.

3. Species specifics

As already mentioned, the more you know about the animals you work with,
the more effective you can be with designing your experiment, controlling vari-
ables, monitoring changes, and producing meaningful results. Laboratory Animal
Medicine by Fox, et al. [2002] may be a valuable resource. Tables from this text
provide a reference on normative data for the mouse and rat. This information is
general, but can guide you. Whenever possible, gather more specific information
for the strain and sex you are working with. Here are some interesting facts to keep
in mind:

1 Mice thrive in a narrow ambient temperature range of 21-25°C (70-77°F).
Due to their high ratio of body surface to body mass, they would go into shock
from dehydration if they depended on evaporation for cooling. Consequently,