

THE UNIVERSITY OF NEW ENGLAND ANIMAL ETHICS COMMITTEE (AEC)

STANDARD OPERATING PROCEDURES FORM

(For Domestic Fowl, Native Fauna/Wildlife, Domestic Livestock & Laboratory Animals)

Title of Procedure:

Computed Tomography (CT scanning) (L14)

Objective:

CT scanning makes use of the differential attenuation of x-rays that exists between the major tissues in the body, in much the same way as conventional film-based radiography does. A conventional x-ray casts a shadow on a photographic plate, but as with a shadow cast on the ground, there is no perception of depth. In contrast, a CT scanner integrates information from a large number of conventional x-rays to form a detailed two-dimensional image of a cross-section of part of the body. This information is obtained by rotation both an x-ray source and a bank of detectors around the body and collecting shadows at every half degree of rotation. These shadows are then integrated by a computer to form a detailed two-dimensional image of the body section. Areas, linear dimensions and densities of components within the slice can be calculated from the two-dimensional slice. Depending upon the magnification used the final image has a resolution of 0.7 to 1.72mm².

The CT scanner can be used to obtain detailed two-dimensional images of a slice of a body. The objective may be to obtain simple measurements of the size or shape of a component within that slice. However, more often the objective may be to provide an estimate of body composition of an animal.

Utilising the CT scanner as a method of estimating body composition has several advantages over other *in vivo* procedures. Firstly, it provides accurate estimates of the weight and locations of various tissues in the body. Secondly, these estimates can be summed over the whole body to provide an estimate of total body composition. The latter estimate does not rely on prediction equations, as for most other imaging techniques, but on a frequent sampling of the body of calculation of weights of components.

Class of animals:

Sheep, goats, deer, calves (bovine), dogs, guinea pigs and chickens have been scanned but other animals are possibilities. The greatest restriction is the diameter of the animal, which must have a diameter no greater than 500mm.

Details of Procedures:

As the CT scanner is not mobile, animals must be delivered to the CT scanner building. There is a room in which a number of animals can be held prior to scanning, or they can be transported in animal house trolleys, cages or other approved containers directly from pens to the CT scanner.

Each animal must remain as still as possible during scanning to achieve good image quality. This is achieved by strapping the animal to a specially designed bed (sheep, dogs, calves and deer), or restraining in a pain-free bag (such as an orange bag – chickens and guinea pigs). The period required to scan one animal varies from approximately 3 to 5 minutes, depending on how many scans are required. In some cases, sedation is necessary to keep the animals still – details are given below.

Once restrained and sedated (if necessary) the animal is placed onto the scanner bed. The CT scanner technician then scans the animal. The details of scanning vary, depending on the nature of the experiment and the number of slices to be taken per animal. However, if complete body composition information is required then the procedure is as follows.

The first part of CT scanning is to perform a scout scan, giving a longitudinal image of the animal. This image gives a view of the animal in a coronial or sagittal plane and is then used to accurately locate the positions for scanning. Some procedures may require slices to be taken at specific locations whereas others may require regular slices at fixed intervals along the animal. If specific locations are required the technician (in consultation with the researcher) must be familiar with locating these positions from the scout. Using pre-determined protocols, which are then adjusted to suit individual animals, the animal is now ready to be scanned. The actual scanning of the body to generate the required data for cross-sectional images to be reconstructed only takes up to approximately 1- 2 minutes. A further 2 – 3 minutes is required for the image reconstruction to be completed. If any of the images are unsuitable for analysis either the whole animal or specific areas are re-scanned. When all required scans have been taken and are of suitable quality the animal is removed from the scanner and released from its restraint. If the animal has been anaesthetised, it is placed in a recovery position. At the end of the day's scanning, the animals are returned to their paddock or pen.

Drug, Chemicals or Biological Agents:

Drug use is avoided where possible, but is necessary in some cases. When sedation is required Xylazine (Xylazine hydrochloride) is normally used. The degree of sedation and analgesia will depend on the dose rate given. Take care with old and debilitated animals. Excitable or fractious animals may require the higher dose rates. Ruminants are the most sensitive of the domestic animals to the actions of Xylazine requiring a little as 1 tenth the dose levels required in horses dogs and cats.

Individual responses to the drug vary but the following dose rates are used to provide moderate sedation or immobilisation and analgesia:

Sheep and goats – Xylazine 20mg/mL (2% w/v), **intramuscularly**. See table 1.

Table 1. Dose rates for sedating sheep or goats with Xylazine 20mg/mL

Species	mg/kg	mL/40kg
Sheep/Goats	0.01 - 0.22	0.02 - 0.44

Deer (need to be anaesthetised for scanning) – Xylazine 100mg/mL (10% w/v) in conjunction with Ketamine (hydrochloride) 100mg/mL (10% w/v), **intramuscularly (use half the dose rate when administered intravenously)**. See table 2.

Table 2. Dose rates for immobilizing deer with Xylazine 100mg/mL

Species	Xylazine		Ketamine	
	mg/kg	mL/40kg	mg/kg	mL/40kg
Fallow	4.0	1.6	4.0	1.6
Red	2.0 – 3.0	0.8 – 1.2	2.0 – 3.0	0.8 – 1.2
Chital	1.5 – 2.0	0.6 – 0.8	1.5 – 2.0	0.6 – 0.8
Rusa	2.0 – 3.0	0.8 – 1.2	2.0 – 3.0	0.8 – 1.2

Xylazine anaesthesia in deer is reversed using Reverzine® (Yohimbine hydrochloride) 10mg/mL (1% w/v), **intravenously**. See table 3.

Table 3. Dose rates for reversing the action of Xylazine in deer with Reverzine® (Yohimbine hydrochloride 10mg/mL)

mg/kg	mL/40kg
0.2 - 0.25	0.8 – 1.0

NB: Overdosing with Xylazine is dangerous, especially in sheep, leading to respiratory failure, so monitoring of animals while sedated or anaesthetised is important. The condition of the animal is also important for determining the correct dose rate as fat animals may rapidly absorb Xylazine into their adipose tissue which is slowly released back into the bloodstream and may effectively overdose the animal.

For appropriate sedation of species not covered above please contact the university veterinarian or contracted veterinary practitioner to discuss the most appropriate sedative and dose rates to use.

Care of Animals after the Procedure:

Fasting (including withholding water) for 12 hours prior to scanning and an injection of antibiotic are recommended as a safeguard against inhalation pneumonia.

Qualifications, Experience, Skills or Training Necessary to Perform this Procedure:

Experience in handling the species that is to be scanned is the only necessary qualification. The CT scanner is operated by a licensed experienced technician. If sedation or anaesthetization is necessary qualified personnel are present to perform these duties (technical staff, researchers or veterinarians). Only suitably qualified assistants are engaged to assist with the animal procedures and will be named on the Animal Ethics approval.

Effects of Procedure on Wellbeing of Animals:

CT scanning itself has little or not effect on the well-being of the animal although excessive irradiation of the genitalia or developing foeti may result in fertility problems or birth defects. However, this is extremely unlikely to occur at the levels of exposure to x-rays the animals currently receive, even with repeated scanning.

Drugs used to sedate or anaesthetise the animal may have an effect on animal well-being. Xylazine causes a reduced feed intake for 1-3 days after administration – this is an important consideration if the experiment is a growth trial. If a general anaesthetic is given all the usual precautions are necessary but special attention must be paid to stopping liquid (saliva or rumen contents) being inhaled. This is facilitated by fasting the animals prior to scanning and elevating the neck of the recumbent animal to help any fluid drain out the mouth. Neither Xylazine nor a general anaesthetic should be given to animals in mid-to-late pregnancy.

Pain Relief Measures:

None necessary.

References:

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Prepared by: Dr Neville Jopson (now with Abacus Bio) and Ruth Tremont (UNE Director of Animal Welfare 1992).

Reviewed by: Professor Steve Walkden-Brown, Environmental and Rural Science, and Mr Andrew Blakely, Environmental and Rural Science, 2014

Reviewed by: Professor Steve Walkden-Brown, Environmental and Rural Science 2016 & 2019

Approved by: Animal Ethics Committee 2019