Blood Pressure Measurement in Less Commonly Used Species

(Part 1 –Mini Pig, Cat and Ferret)

Although the majority of blood pressure research is performed on three species (rats, dogs, and primates), the technical staff at DSI is often contacted by investigators who wish to use a different animal species. This technical note will provide specific information regarding surgical protocols, transmitter model selection, and hardware and software configuration for some of the most frequently used miscellaneous species.

The need to measure blood pressure in species other than the standard ones for which our equipment was designed requires an investigator to define certain conditions to assure proper data collection. The appropriate transmitter model should be selected based on the animal's body size, the vessel to be cannulated, and the required transmitting distance. The surgical protocol should be defined based on the surgeon's experience and the idiosyncrasies of the species selected. The next step is to determine the cage size vs. transmitter model so that the necessary receivers can be installed to provide adequate signal reception. The final step is to set up the animal in the Configuration module of the Dataquest® software to allow accurate data calculation. The following are protocols that have proven successful for DSI customers monitoring blood pressure. Whenever possible we have taken information directly from users to assure that the method has been used successfully in the field.

SPECIES: Mini Pig

The mini pig is fast becoming a popular choice for investigators doing cardiovascular studies. Mini pigs have a similar heart to body weight ratio as humans, uniform regional distribution of circulation, and low coronary collateral circulation. The pig is similar in body size and conformation to a dog. The surgical protocol for the pig is identical to that of the dog. The vessel most commonly cannulated is the femoral artery or a branch of the femoral artery. The transmitter body is placed under the skin in the flank region.

Swine are a "fixed-skin" animal similar to humans, with no loose subcutaneous tissue. This makes placement of the transmitter body and tunneling of the catheter somewhat more difficult. However, the procedure should be similar to dogs. There may be an increased risk of seroma formation at the site of the transmitter body due to the tissue trauma associated with making a subcutaneous pocket.

The anesthetic regimen most commonly used in swine is induction with ketamine (33 mg/kg IM) and atropine (60 g/kg, IM) and maintenance with Isoflurane. The transmitter model best suited for use in swine is the D70 model. This model was designed for use in primates and dogs, and works very well for swine. Housing for swine is usually similar to dog housing. Transmitting distance for the D70 model is 1 m x 1 m x 1 m. The typical cages used for dogs are

approximately this dimension and require the use of one receiver to provide adequate coverage. Runs may be considerably larger and will often require multiplexing several receivers. The RMC-1 water resistant receiver should be used in pig housing.

The software configuration includes a species designation for swine. By selecting this species designation, the software will automatically set the appropriate default values for collecting accurate pressure and heart rate data.

SPECIES: Cat

Cats are generally considered a difficult research species. They respond poorly to confinement and can be difficult to handle. They are, however, a species of intermediate body size and may be more suitable than dogs or rats for some protocols. The surgical protocol used in cats will depend on the transmitter model selected.

The cat is midway in body size between the dog and the rat, so neither the rat transmitter (C40) nor the dog transmitter (D70) is completely appropriate. Some investigators have chosen to use the C40 model because of its smaller size. If the C40 is used it should be equipped with a longer than standard catheter. The standard catheter length is 8 cm and 0.7 mm O.D. We recommend a 15 cm catheter be placed on the transmitter. If the D70 is chosen as the transmitter model, it may be necessary to place a different catheter on it. The D70 comes standard with a 25 cm, 1.25 mm O.D. catheter. This may be too large a catheter for use in smaller cats. The 0.7 mm catheter can be ordered on the transmitter and may be more appropriate in some cases.

The two vessels most commonly cannulated are the carotid artery or the femoral artery. If the carotid artery is used, the body of the transmitter is typically placed subcutaneously in the neck. If the femoral artery is used the transmitter body can be placed subcutaneously in the flank or in the groin area. The body of the C40 is cylindrical in shape. It is best suited for intraperitoneal placement, however it has been placed successfully subcutaneously. It is necessary to place the transmitter body in an area with loose skin. This will allow it to lie comfortably under the skin. To avoid clotting and loss of signal the catheter must be placed far enough into the chosen artery to position the tip within flowing blood. The vessel being cannulated is typically ligated, stopping flow of blood in that vessel. Therefore, the tip will need to be past the closest vessel branching off the artery to assure placement within flowing blood. Placement of the D70 transmitter body will be similar to the placement of the C40 in the case of femoral artery cannulation. For carotid cannulation, transmitter body placement should be along the lateral thoracic wall.

The anesthetic protocol most commonly used in cats is induction with a short-acting barbiturate (i.e. Thiamylal sodium, 17.5 mg/kg IV) and maintenance with Isoflurane. The transmitting distance for the C40 is 42 cm x 42 cm x 25 cm. The standard cat cage is larger than this and will require the use of multiple receivers to provide coverage. The transmitting distance of the D70 (1 m x 1 m x 1 m) is adequate to cover a standard cat cage with one receiver.

The software configuration does not include a designation for cats. By using the advanced editing features a custom species can be created. However, creating a custom species is seldom necessary, as values for blood pressures and heart rates are similar to that of rabbits. By selecting the rabbit as the species, the default values will allow accurate extraction of parameters from the pressure waveform in cats.

SPECIES: Ferret

Ferrets are a species that is becoming increasingly popular. Their small size and relative ease of handling makes them attractive subjects for many studies. Ferrets are best suited for intraperitoneal implantation of the C40. The procedure would be the same for a rat.

The transmitting distance of the C40 (42 cm x 42 cm x 25 cm) will require more than one receiver per cage. Ferrets are usually housed in cages that are 61 cm x 74 cm x 48 cm. These are somewhat larger than those required for rats. It may be necessary to multiplex receivers to cover the larger cage.

The software configuration does not include a designation for ferrets. By using advanced editing features, a custom species can be created. However, values for blood pressures and heart rates are similar enough to that of rats so that by choosing the rat as the species, the default values will allow accurate extraction of parameters from the pressure waveform in ferrets.