Webinar Q&A Report:
SuperArgus PET/CT: Advanced Pre-Clinical Imaging for Small to Medium Animals

1. **Are there any special room requirements for installing the SuperArgus PET/CT System?**

   Tonya Coulthard: No, the system is self-shielded to meet regulations set out by the FDA for X-ray auto-shielded cabinets. This is for the CT component of the system, to ensure that anyone who remains in the room is not exposed to radiation. So, no lead walls are needed or a lead wall or lead crystal between the operator and the machine.

   However, when using PET imaging, a radioisotope is injected into the animal, which inherently involves a radioactive tracer. Therefore, there are considerations in handling the tracers and animals post-injection to ensure that those handling the radioisotopes are protected.

   A space to safely prepare, calibrate and inject the radiotracer is required, along with monitoring equipment to ensure that radiation is contained and cleaned once the imaging session is complete. Special holding areas for the animals may also be required depending on the injected dose, the isotope used and its half-life. These considerations are required whenever performing PET imaging, regardless of the specific system being used. These rules and regulations are set by the government of each country or region, so always check with your facility.

2. **What radioisotopes can be used with the Sedecal system?**

   Tonya Coulthard: All PET radioisotopes, without restriction can be used with the SuperArgus system from Sedecal.

   For new PET users, this includes Fluorine-18, Carbon-11, Oxygen-15, etc. Most important however is the half-life of these isotopes, and the location of the nearest source, for example a cyclotron. For example, if you wanted to use Oxygen-15 in your studies, the half-life is around 2 minutes. This would require that you are very close to the cyclotron or source of this tracer. However, if you are using FDG for example, the half-life of

Fluorine-18 is 110 minutes, so the usable life of a sample is much longer and the logistics of planning your study will be much simpler.

3. **Is the only option for multi-animal handing the 4-mouse configuration you showed in your presentation?**

   Tonya Coulthard: No. The configuration shown is the commercially available option that Sedecal has designed, both a 3-mouse or 4-mouse option may be selected. However, we can work directly with you to figure out a configuration of number of beds and size of animals that you need to work with your specific studies. The possible configurations will depend on your research needs, but also on the bore size of the system that you have or are looking to purchase. This should all be taken into consideration when deciding on the specific SuperArgus model.

4. **With regards to PET/CT imaging, what is cardiac gating?**

   Tonya Coulthard: Cardiac gating is used in PET/CT imaging to gate the PET image. In doing this type of gating a dynamic image of the heart beating over time can be generated, as was shown in the presentation. Typically, a collection of dynamic images are generated showing the beating of the heart throughout the entire heart, for example in a short axis view from apex to base.

   There are two ways to complete this type of imaging on the SuperArgus system. First, the ECG signal may be obtained from the animal by connecting it to a physiological monitoring system, and this signal is then fed into the SuperArgus electronics. The image acquisition is synced to the ECG signal, and therefore the cardiac cycle, so upon reconstruction the algorithm is aware of where the images were acquired within 3-dimensional space as well as when they were acquired within the cardiac cycle.

   The second way to acquire a gated cardiac image on the SuperArgus system is sensor-less; no ECG leads or physiological monitoring is required. In this scenario the radiotracer must reach the myocardium, so that the reconstruction algorithm has some signal to work with. The acquisition must be at least 4 seconds in length, to provide several cardiac cycles to work with. The reconstruction algorithm is then able to generate images comparable to the set resulting from the ECG gated images described above. That is a stack of images throughout the heart showing the dynamic beating of the heart through the entire cardiac cycle.

5. **Do radiotracers or the scan itself have a deleterious effect on animal models? Would it be possible to use this technology several times on the same animal, for example to track the progression of tumour growth?**

Tonya Coulthard: No, the radiotracers or the scan itself do not have a deleterious effect on the animals; yes, the SuperArgus system can be used on the same animal at multiple time points over the course of a longitudinal study to track tumor progression.

The radiotracers do emit some radiation, this is what aids in their detection while acquiring a PET image. The dose is controlled such that the animal is not given too high of a dose; this is both to reduce the use of the expensive radiotracer and to limit the amount of radiation the animal is exposed to as a result of the tracer.

The CT component of the SuperArgus system has pre-set acquisition parameters designed to give a rapid acquisition (approximately 15 seconds) providing a very good image (50-100µm) to provide anatomical context to the acquired PET data. The design of the SuperArgus system includes components and CT reconstruction algorithms which allow this type of image to be acquired with minimal exposure to radiation for the imaging subject.

Combined, these considerations in PET imaging and the design of the CT component of the SuperArgus system provide no deleterious effects to the animals during an imaging session. Thus making PET/CT with the SuperArgus system an ideal way to track the growth of tumors, or to be used in any other longitudinal study where numerous imaging sessions are performed at various time points.

6. **Is the CT a fan beam or a cone beam?**

Tonya Coulthard: The SuperArgus systems use a cone beam CT.

7. **Have you used Cu-64 as a radioisotope, for example to track antibodies at 24 or 28hrs after injection? Does the SuperArgus System have the sensitivity for this type of study?**

Tonya Coulthard: Yes, this type of imaging has been performed using the system. With Cu-64 having a half life of 12.7 hours there is enough signal, and the system is sensitive enough, to be imaged after 24-28 hours (2-3 half lives). By comparison, the system has been used to image F-18 (FDG) 24 hours (13 half lives) following injection.

8. **How can you avoid or diminish the strong signal from harderian glands?**

Tonya Coulthard: The effect of the harderian glands on mouse brain imaging is well documented, this is independent of system being used to perform PET imaging. A quick search shows many publications looking at the effect of adenectomy of the gland to help reduce the interference on PET images. It would be best to review several journal publications to determine the best approach for your research application.

9. What are the size differences among systems with different bore sizes or ring configurations?

Tonya Coulthard: See the table below for details on dimensions and weights for all the system models.

Bore Size	Number of PET Rings	System Dimensions			System Weight (kg)
		Length (mm)	Width (mm)	Height (mm)	
100mm (r model)	2/4/6	1670	960	1520	850
160mm (R model)	2/4/6	2100	1324	1618	950
260mm (P model)	2/4/6	2300	1320	1620	950

10. What is the maximum diameter that an animal can be to fit inside the system?

Tonya Coulthard: Almost the entire bore of the specific model is available to fit the animal to be imaged inside. In addition to the animal one must consider the bed as well as any other peripheral devices that are to be put inside the bore with the animal.

The r (100mm) model can fit animals such as mice, rats and marmosets. The animal holder can support up to 1kg, however the user must consider the length of the animal along with any other peripherals which are to be included during the imaging session.

The R (160mm) model can fit animals such as rabbits and similarly sized animals up to 6kg. In addition to single animal imaging, this system can fit the multi-animal handling system to fit 4 mice, for example, in the available system. Sedecal and Scintica Instrumentation are happy to work with you to customize a multi-animal handling system to meet your needs.

The P (260mm) model can fit animals such as non-human primates, and similarly sized animals up to 10kg. This system can also be configured to work with multiple animals, working with Sedecal and Scintica Instrumentation to configure a system which works to meet your needs.

11. Is it possible to integrate data from this system with other imaging modalities such as MRI?

Tonya Coulthard: Yes. Images from the SuperArgus system can be exported as DICOM or Interfile formats. Both formats are easily input into third party software, such as VivoQuant. Images from other systems, such as MRI, can also be input into the VivoQuant software. The tools available within this software allow you to co-register these images and perform analyses on the multi-

modal images. It is important that where possible the animal remain in the same position between systems; again the team at Sedecal and Scintica Instrumentation are willing to work with you to develop a solution to meet your needs.

12. How does the sensitivity of the multi-plex PET, which measures triple coincidences, compare to the sensitivity of SPECT?

Tonya Coulthard: This is a challenging question to answer as there is a lot of variability between PET and SPECT inherently, and between manufacturers' specific systems. The main difference is that SPECT systems use collimators while most PET systems do not. In general, however, PET systems are approximately 25-30 times more sensitive then most SPECT systems on the market.

When considering multi-plex PET, the challenge continues. This is a newly developed technology and the direct comparison has not been made at this time.

Contact Information

If you have additional questions for Tonya Coulthard or Scintica Instrumentation regarding content from this webinar, or if you want to receive additional information about their products and laboratory services, please contact them by phone or email:

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