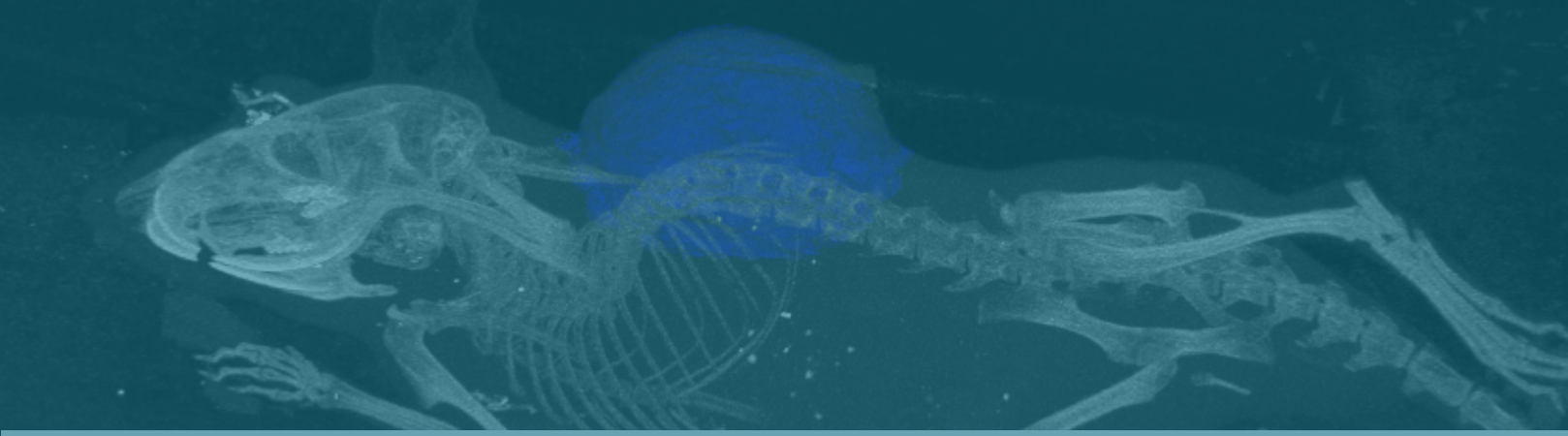

MOLECUBES
MODULAR
BENCHTOP
IMAGING

MicroCT imaging in preclinical oncology

Micro Computed Tomography (microCT) imaging is a powerful tool for preclinical oncology, offering many benefits to researchers and scientists in the field. One of the most significant advantages of microCT is its ability to provide detailed, high-resolution three-dimensional images of animal and human tissues, including bones, organs, and tumors at various timepoint within the same animal, in a humane manner. This capability enables researchers to longitudinally study and quantify the anatomy and physiology of the tissue, as well as to monitor the progression and development of diseases such as cancer within the same animal over time.

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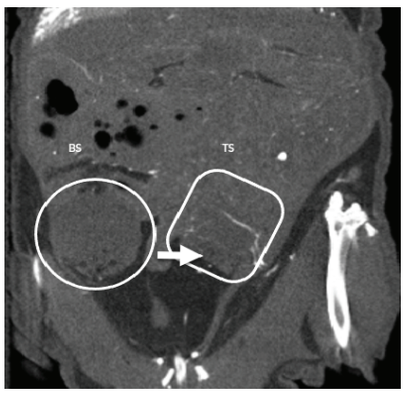
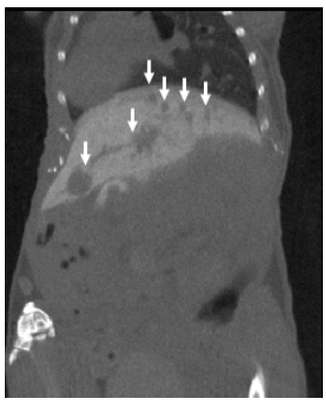
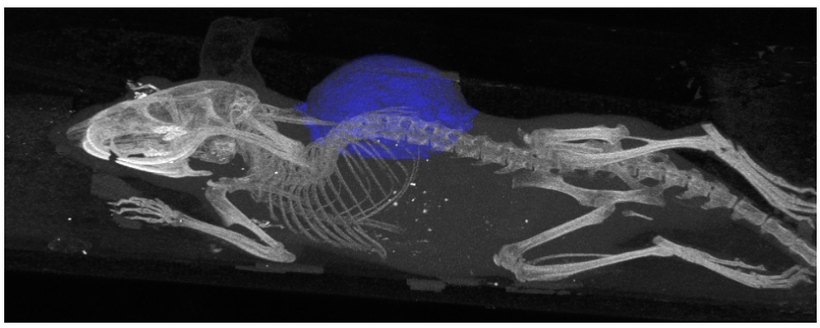
② 

③ 

④ 

1. Monitoring of bone metastases formation in a breast cancer rat model. CT imaging enabled quantification of tumor burden and metastases volume. Adapted from De Meulenaere et al., 2018.
2. CT imaging of vessel formation in a tumor scaffold. Exitron 12000 was used as a contrast agent to visualize and quantify angiogenesis. BS= blanco scaffeld; TS = tumor scaffold. Adapted from De Jaeghere et al., 2018.
3. DEN induced hepatocellular carcinoma in a mouse. Contrast enhanced CT with Exitron 6000 was done to follow up tumor development.
4. Prostate cancer mouse xenograft. Tumor segmentation visible in blue. Adapted from Piron et al., 2021.

A powerful tool in the modern in vivo oncology lab

Within the preclinical oncology space a trend towards orthotopic tumor models can be observed. These models promise more clinically relevant information on disease models and therapy research, as the complex interplay with tumor micro-environment can influence cancer cell behavior, such as promoting angiogenesis, supporting tumor growth and survival, and contributing to resistance to chemotherapy and radiation therapy.

Even with more traditional subcutaneous tumor models, microCT imaging is especially useful to provide the full, 3D, tissue images which are not dependent on operator measuremet (and hence bias) as is the case with caliper meaurements.

MicroCT imaging offers high resolution volumetric imaging of the anatomy of living small animals (e.g. mice, rats) and has proved to be useful in for example monitoring of bone metastases formation (De Meulenaere et al., 2018). The greatest utility of micro-CT is detection of metastases throughout the body of the animal thanks to its full body imaging capabilities, providing a tool for evaluating treatment strategies. Similarly, micro-CT has been used to measure and quantify bone and tumour volumes in the evaluation of new treatment options for lung cancer, liver cancer and many others.

Revolutionized with the MOLECUBES factor

Molecubes' vision since its inception has been to make the power of in vivo imaging available to any lab. This vision has translated into a line of bench-top ready and easy-to-use imaging systems, without performance compromise, and a passionate team ready to hit the ground running to enable any in vivo team to embrace small animal PET, SPECT, and/or CT imaging.

Case: Follow up of tumor growth in a murine model

The value of imaging

Study context

In this study, CT imaging was used to follow up the development of lung tumor nodules over time in two mouse models. In mouse model 1, tumor cells were inoculated in the left lung (Figure 1). Mouse model 2 is a conditional mutant in which a local viral delivery of Cre enables oncogene Kras G12D mutation and p53 gene deletion (KP mutant mice), further driving tumor development (Figure 2). At each time point, anesthetized mice were positioned in a multi animal cradle, allowing imaging of 4 mice at the same time. A localized scan imaging the lungs of the animals was acquired within a few minutes. Image processing was semi-automatized using Vivoquant or PMOD software.

What data can be derived?

By segmenting left and right and total lung and intra-lung intermediate density tissue volumes, the tumor growth is monitored over time within the same animal. Additionally, by calculating the average HU in the segmented volumes the tissue density of those regions can be studied providing information on cell proliferation.

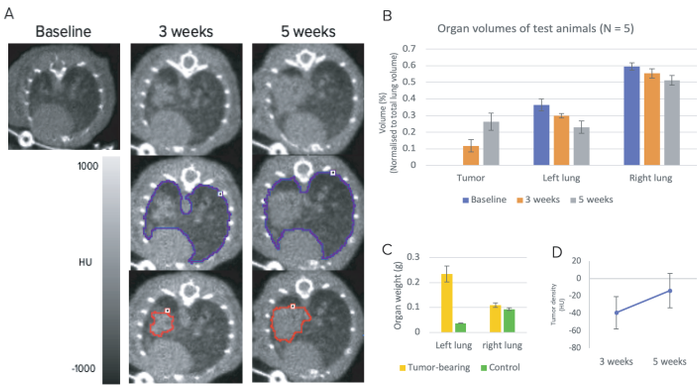


Figure 1. CT imaging for lung orthotopic xenografts monitoring. Growth of tumor cells injected in the left lung can be longitudinally evaluated (baseline, 3 weeks and 5 weeks post) tumor growth can be evaluated of time (baseline, 3 weeks and 5 weeks post inoculation of tumor cells) using CT imaging and segmentation of the organ volumes (A). Tumor volume (%) was obtained by normalizing soft tissue segmentation (region of interest in red, A) to total lung volume (region of interest in blue, A) (B). increased left lung weights at study endpoint (5 weeks) from tumor-bearing (N=21) indicate tumor growth inside the organ compared to control mice (N=8) (C). Increase in tumor density over time as measured by increase in HU values in the tumor region of interest (D).

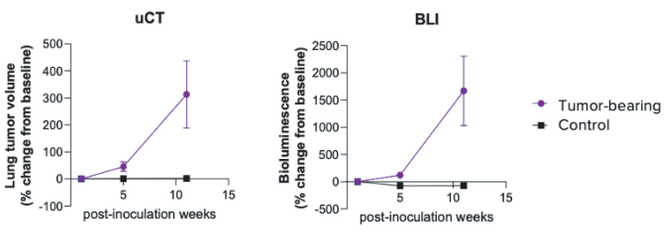


Figure 2. CT monitoring of tumor growth correlates with bioluminescence signal in mouse model 2. KP mutant mice were imaged before (i.e. baseline) , 5 and 12 weeks post tumor induction via intranasal injection of Lentivirus-Cre-FLuc (as in Lepage et al., 2009). Tumor growth was determined by CT segmentation of soft tissue volume within the lung or whole body BLI signal and expressed as percent change from baseline. N = 9 tumor-induced and 3 PBS control mice.

Comparison with BLI

In mouse model 2, tumors were induced by intranasal injection of lentivirus-Cre-Fluc in KP mutant mice, allowing to monitor nodule growth using bioluminescence imaging (BLI). Figure 2 shows that CT allows longitudinal tumor burden monitoring similarly to the commonly used BLI technique. However, compared to BLI, CT provides additional information on e.g. the exact location and aspect of the lesion (localised to left or right lung, invasion from left to right side, clustered or diffuse, ...), exact tumor volumes, tumor density,... that might be important information for your research (see mouse model 1 results).

Reference

This data was kindly shared by EARLI Inc. with technical expertise from T. Theile, G. Kumar, B. Cain, M. Goryawala, H. Lee, T. Sproul and N. Morisot