Ultrasound and photoacoustic imaging forming the backbone for the 3R

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The 3R, Replacement, Reduction, and Refinement has an impact on planning of future research projects in preclinical research. The 3R regulates the directions of welfare of animals used in a specific study [1]. The best practice in pre-clinical imaging as a golden standard for reproducibility is required in basic and translational research enabling transfer of knowledge to clinical praxis. High-frequency ultrasound (HFUS) and photoacoustic (PA) techniques are a non-invasive, real-time, and reproducible approach for anatomical, functional, and molecular imaging utilized in various applications. The HFUS and PA imaging is utilized especially in rodents and in bigger laboratory animals. The applications of HFUS include developmental imaging, neurobiology and neuro oncology, cardiovascular research, oncology, biodistribution studies and pharmacokinetics, and others. Here, HFUS gives anatomical and functional information, while the PA imaging provides information about the biodistribution of endogenous or exogenous contrasts on a molecular level. The standardized and reproducible approach in HFUS and PA imaging is helping in reducing the number of animals used in the animal study [2]. Also, the animals require light anesthesia only as the imaging itself is usually done within a few minutes. This has a favorable effect on animal welfare and overall animal condition helping to reduce the recovery time after the necessary examination.

[1] Hubrecht RC., Carter E. The 3Rs and Humane Experimental Technique: Implementing Change. Animals (Basel). (2019) https://doi: 10.3390/ani9100754

[2] O'Riordan, C.E., Trochet, P., Steiner, M. et al. Standardisation and future of preclinical echocardiography. Mamm Genome (2023). https://doi.org/10.1007/s00335-023-09981-4