Correlation analysis of small-animal DXA for bone parameters and total body, fat and lean mass

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INTRODUCTION

Dual-energy X-ray absorptiometry (DXA) can be used for analysing bone and body composition in laboratory animals. Unlike commonly used traditional extraction methods such as ash weight and crude fat weight measurements, DXA can be used for longitudinal monitoring of live anesthetized animals during the study.

AIM

The aim of this study was to validate iNSiGHT small-animal DXA in measuring Bone Mineral Content (BMC), Bone Mineral Density (BMD), Fat Mass (FM) and Lean Mass (LM) in mice and rats, and to confirm their correlation to traditionally used extraction methods.

METHODS

DXA is a measurement technology based on variable absorption of X-rays by different body components. DXA uses high and low energy X-ray photons that are differentially absorbed by bone and soft tissues. DXA measurements distinguish bone from soft tissues due to higher number of calcium and phosphorous atoms in bone, as compared to higher number of carbon, nitrogen and oxygen atoms in soft tissues. Soft tissues include fat and lean tissues. Fat is largely composed of repeated methylene units ((CH2)n), whereas X-ray attenuation of lean tissues is similar to water (H2O). The difference in X-ray attenuation between fat and lean tissues is attributed to the atomic number difference between carbon and oxygen.

Reference image of a small-animal DXA

STUDY DESIGN

The study design is detailed in Figure 1. Eighteen ICR mice and 18 Sprague-Dawley rats were divided into three weight groups (20 g, 30 g and 40 g for mice, and 100 g, 200 g and 300 g for rats; n=6 in each group). Body weight, bone ash weight, crude fat weight and lean weight were measured using a scale and compared with body weight, total body (TB) BMC, fat mass and lean mass, respectively, measured by iNSiGHT DXA. These parameters were analyzed both in anesthetized and euthanized animals. Femur BMC was measured by iNSiGHT DXA before and after euthanasia and compared to values obtained by µCT.

The following comparisons were made:

Body weight:	scale	vs	DXA
Fat mass:	crude fat weight	vs	fat by DXA
Lean mass:	lean mass weight	vs	lean mass by DXA
Total body BMC:	bone ash weight	vs	BMC by DXA
Femur BMC:	BMC by µCT	vs	BMC by DXA

Statistical analysis was performed using Pearson correlation.

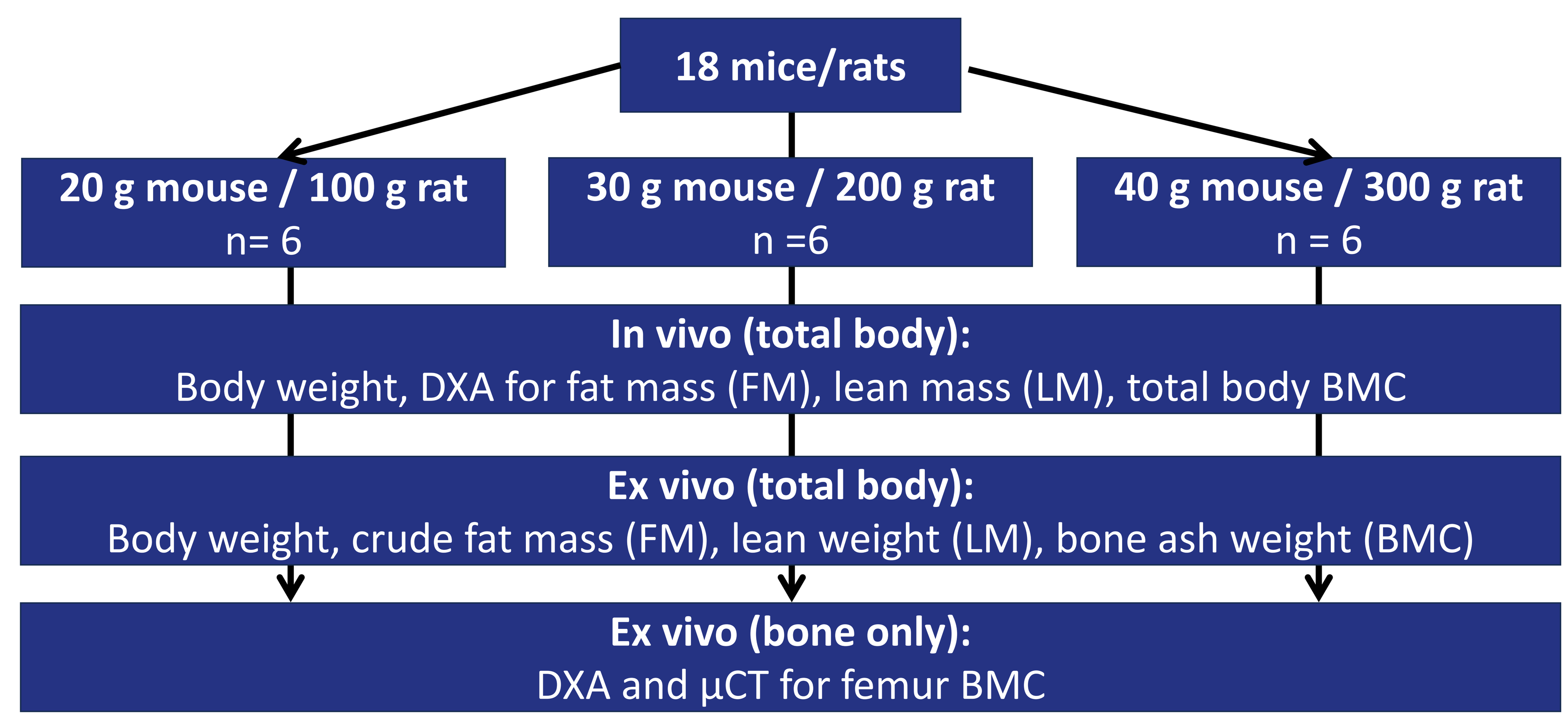

Figure 1. Study design. Mice and rats were divided into study groups based on body weight and all measurements were done for all animals.

RESULTS

The obtained DXA values showed strong correlation with actual body weight, fat and lean mass. BMC obtained with DXA showed strong correlation with BMC calculated from µCT analysis and with bone ash weight in both live and euthanized animals (Table 1). Similar high correlations were observed in both mice and rats, demonstrating that DXA can be used to analyze reliably changes in the above-mentioned parameters in commonly used small laboratory animals (reference DXA image shown on the right).

Table 1. Summary of Pearson correlations between parameters in anesthetized and euthanized mice and rats.

	Anesthetized					*Euthanized*				
Pearson correlation	**Body weight**	**FM**	**LM**	**TB BMC**	**Femur BMC**	**Body weight**	**FM**	**LM**	**TB BMC**	**Femur BMC**
Mouse	0.9995	0.9702	0.9964	0.9990	0.9660	0.9926	0.9804	0.9759	0.9945	0.9806
Rat	0.9996	0.9961	0.9999	0.9991	0.9964	0.9996	0.9934	0.9962	0.9982	0.9919

CONCLUSIONS

DXA provides an easy, rapid and accurate method for analyzing both bone and body composition. In this study, we have demonstrated that there is a strong correlation between the parameters obtained by DXA to the traditionally used chemical extraction method. DXA therefore provides a valid tool for measuring changes in bone and body composition in commonly used laboratory animals.

"DXA is a rapid and accurate imaging method that can be utilized in bone and metabolic research. Key advantages over other imaging methods include whole-body imaging capability and analysis of user-selected multiple ROIs during the study."

SELECTED REFERENCES

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CONTACT INFORMATION & DISCLAIMERS

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ONCOBONE OsteoSys

OncoBone is European distributor of the small-animal DXA iNSiGHT of OsteoSys, read more at: https://oncobone.com/insight-small-animal-dxa