Purpose: To investigate the combination of PET/MR image features for the early prediction of tumor metastases to the lungs in soft-tissue sarcoma (STS) cancer.

Methods: A dataset of 24 patients with histologically proven STS was used in this study. All patients underwent pre-treatment FDG-PET and MR scans, which comprised of T1 and T2-fat suppression weighted (T2FS) sequences. The patients had a median follow-up period of 36 months (range: 6-69 months). Eight patients developed metastases to the lungs. Tumors were contoured on the T2FS scans by an expert physician. Fusion of the co-registered FDG-PET/MR scans was performed using a wavelet transform technique. A SUV feature (SUVmax) from the FDG-PET scans and 6 texture features from the co-occurrence matrix of the fused scans were extracted from the tumor region and correlation with the clinical endpoint of metastases to the lungs was investigated. Statistical analysis was performed using Spearman's rank correlation (rs) and multivariable logistic regression.

Results: The highest univariate prediction was found on FDG-PET/T2FS fused scans analyzed using the texture features "Sum-Mean" and "Variance". These two fused scan--texture feature combinations reached rs = -0.6838 (p = 0.0003). In comparison, SUVmax reached rs = -0.6257 (p = 0.0011). The highest multivariate prediction was found with the following 3-parameter model: -3.15*SUVmax - 5.37*FDG-PET/T2FS--Sum-Mean + 0.57*FDG-PET/T1--Variance. This model reached rs = 0.7977 (p = 0.000005).

Conclusions: This work indicates the potential of PET/MR texture features of tumors as complementary metrics to existing prognostic factors. Substantial improvement in terms of prediction of metastases to the lungs in STS cancer was found with the combination of texture features from fused FDG-PET/MR scans. Potentially, this could improve patients' outcomes by allowing better adaptation of treatments. Future work will involve evaluation of the robustness of the proposed method and validation on a larger set of patients.