Purpose: Current hepatic dynamic contrast enhanced CT (DCE-CT) protocols rely on patients holding their breath either once or multiple times. We propose that hepatic CT perfusion imaging is feasible using a free breathing DCE-CT scanning protocol without prior coaching on breathing and automatic post acquisition image registration to eliminate motion induced artifacts.

Methods: 26 patients (21 males, 5 females, average age 71 years) with primary or metastatic hepatomas were scanned with a free-breathing axial shuttle DCE-CT. One-dimensional respiratory motion correction in the axial direction was performed automatically by registering high contrast liver features in every image to that of a chosen reference image. CT Perfusion (GE Healthcare) was extended to calculate root mean squared deviation (RMSD) maps to quantify the amount of respiratory motion before and after motion correction. Functional parameters were generated for both corrected and uncorrected scans to determine the effect of motion induced artifacts.

Results: Within the liver, background levels of RMSD due to tissue inhomogeneity, imaging noise and reconstruction artifacts was found to be less than 20 HU. A threshold of 200 HU was chosen to indicate organ motion. The mean fraction of voxels in the liver with RMSD above 200 HU (VF) decreased from 8.0% to 4.0% after correction ($p=0.01$). A strong correlation was found between initial VF (VFI) and reduction in VF (DVF) due to motion correction ($DVF = 0.94*VFI - 3.66$, $R=0.97$). Total blood flow was 30 ml/min/kg ($p=0.08$) higher in tumour than normal tissue prior to correction and 40 ml/min/kg ($p=0.008$) after correction.

Conclusion: Free breathing DCE-CT in liver is feasible and using a posteriori motion correction reduces potential motion artifacts in functional maps. Motion correction is beneficial in cases where initial VF is greater than 5% or an ROI can not be drawn that includes the portal vein in all volumes.

Funding Support, Disclosures, and Conflict of Interest:

"This research is funded by the Canadian Cancer Society (grant #700386)".