Dynamic contrast-enhanced magnetic resonance imaging and dynamic contrast-enhanced computed tomography of primary colorectal cancer: Comparison of test-retest agreement.

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Background: Colorectal cancer remains one of the commonest cancers worldwide. Assessment of tumour vascularisation and angiogenesis may provide prognostic and predictive information in the same primary colorectal cancer cohort. This may be evaluated using dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) and dynamic contrast-enhanced computed tomography (DCE-CT), each with its own advantages and limitations. To date there has been limited evaluation of test-retest agreement and no direct comparison of the techniques in the same patient cohort. The reproducibility of a technique (test-retest agreement) is highly relevant to clinical practice. The aim of this prospective study was to compare the test-retest agreement of dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) and dynamic contrast-enhanced computed tomography (DCE-CT) in primary colorectal cancer.

Materials and Methods: Following ethical approval and informed consent, 14 patients (12 male, 2 female, mean age 67.1 years) with primary colorectal adenocarcinoma underwent both DCE-MRI and volumetric helical DCE-CT following intravenous injection of contrast (0.1mmol.kg\(^{-1}\) gadolinium-DTPA at 4ml.s\(^{-1}\) and 50mL of 350mg.mL\(^{-1}\) iodine contrast at 5-6mL.s\(^{-1}\) respectively) prior to chemoradiation and surgery to derive transfer constant (K\(^{\text{trans}}\); min\(^{-1}\)), rate constant (k\(_{ep}\); min\(^{-1}\)), volume of the extravascular extracellular space (v\(_e\); %) and area under the Gd curve at 60s (AUGC\(_{60}\); mmol.s) by DCE-MRI (Tofts/Kety model with an assumed AIF), and regional blood flow (BF; ml.100ml\(^{-1}\).min\(^{-1}\)), regional blood volume (BV; ml.100ml\(^{-1}\)) and flow-extraction product (FE; ml.100ml\(^{-1}\).min\(^{-1}\); new nomenclature for CT permeability) by DCE-CT (Initial maximum slope/Patlak model). Volumetric helical DCE-CT parameters: 100kV, 120mA, 4D adaptive spiral; scan interval 1.5s, slice thickness 5mm, z-coverage 11-16cm, matrix 512\(^2\), acquisition time 1min. DCE-MRI parameters: 4.76ms TE, 7.38ms TR, 18\(^\circ\) flip angle, 40 repeats of 12x 5mm slices, FOV 300mm\(^2\), 512\(^2\) matrix, usable coverage 3cm, acquisition time 6min. The DCE-MRI and DCE-CT studies were repeated within 48 hours of each other, and test-retest agreement assessed using Bland-Altman statistics. Parameters were natural log transformed where Kendall’s tau was positive (P<0.05) or when the distribution was non-normal.

Results: Studies were completed in 12/14 patients. Mean difference, 95% limits of agreement, within-subject coefficient of variation (wCV) and repeatability coefficient for repeat studies (n=12) and different observers (n=2) are shown in Table 1 (units as above).

Table 1 Parameter Mean/mean difference 95% limits of agreement (wCV) Repeatability coefficient r (wCV) MRI #1 K\(_{\text{trans}}\) 0.2761/0.00666 -8.47 to 9.25 11.7 -26.4 to 35.9 MRI #2 K\(_{\text{trans}}\) 0.2557/0.0115 -9.3 to 10.3 13.0 -27.8 to 40.3 CT #1 BF 72.22/1.48 -6.57 to 7.04 8.1 -16.6 to 22.5 CT #2 BF 72.05/4.27 -9.3 11.1 -30.9

Conclusion: Test-retest agreement between readers for both modalities was acceptable for clinical practice. In general the measurement errors for DCE-MRI and DCE-CT parameters were of the same order, but DCE-CT blood flow reproducibility was slightly better; however, the coverage was greater for CT than MRI and it must be noted that DCE-MRI and DCE-CT parameters are not directly interchangeable.

References: