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[1-3]. 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^{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[4] 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^o 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 (% of mean)	wCV %	Repeatability coefficient r (% of mean)
MRI #1	K^{trans}	0.2761 / 0.0066	-8.47 to 9.25	11.7	-26.4 to 35.9
	v_e	33.22 / 0.16	±10.4	12.9	±35.9
	k_{ep}	0.8538 / 0.0107	±12.2	15.2	±42.2
	$AUGC_{60}$ mmol.s	24.311/-0.576	-9.2 to 10.2	12.9	-28.5 to 39.9
MRI #2	K^{trans}	0.2557 / 0.0115	-9.3 to 10.3	13.0	-27.8 to 40.3
	v_e	33.87 / -0.04	±9.1	11.4	±31.6
	k_{ep}	0.7626 / 0.0362	±9.4	11.7	±32.5
	$AUGC_{60}$	22.999 / -0.277	-10.1 to 11.2	14.2	-30.8 to 44.5
CT #1	BF	72.22 / 1.48	-6.57 to 7.04	8.5	-20.2 to 25.3
	BV	9.324 / -1.738	±15.6	18.6	±51.6
	FE	25.972 / 5.368	-15.7 to 18.6	22.6	-43.2 to 76.0
CT #2	BF	72.05 / 4.27	±9.3	11.1	±30.9
	BV	9.405 / -1.294	±21.0	25.2	±69.7
	FE	25.322 / 6.496	-17.8 to 21.6	26.4	-47.7 to 91.2

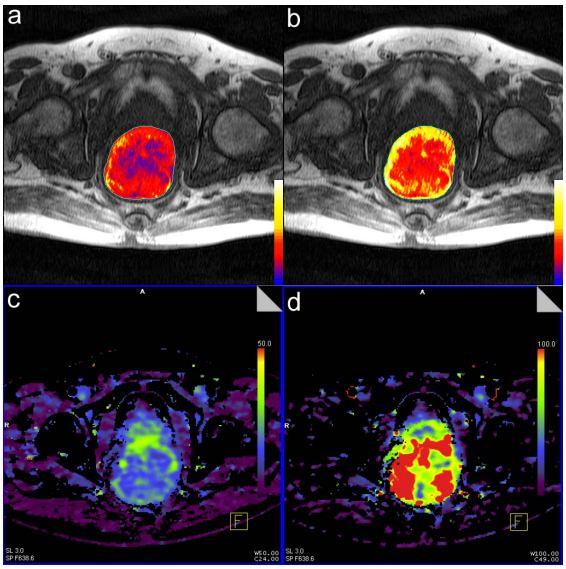

Figure 1a) K^{trans} (0-1min^{-1}) b) $AUGC_{60}$ (0-50mmol.s) parametric overlays on MR images of a T4 rectal tumour; c) FE (0-50ml.100ml^{-1}.min^{-1}) and d) rBF (0-100 ml.100ml^{-1}.min^{-1}) parametric DCE-CT images of the same tumour.

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:

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