Contrast enhanced MRI in neoadjuvant chemotherapy for locally advanced breast cancer: does accuracy vary across clinically relevant sub-sets?

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Introduction: Contrast-enhanced magnetic resonance imaging (CE-MRI) has emerged as a very useful tool in the pre-operative assessment of breast cancer following neoadjuvant chemotherapy [1, 2] and a retrospective study has been undertaken in order to determine the accuracy, as compared to pathology, of CE-MRI maximum diameter measurements in a range of clinically relevant sub-sets.

Methods: A review was carried out of locally-advanced breast cancer patients who underwent neoadjuvant chemotherapy (NAC) between September 2005 and April 2009 (over 3.5 years). MRI was carried out at 3.0 T and at a single centre using either an HDX or MR750 GE scanner (GE Healthcare, Milwaukee, USA) and dedicated bilateral, phased-array coils. MRI included intermediate temporal resolution (c. 30 s), dynamic CE-MRI, high spatial resolution T_1-weighted CE-MRI (both sagittally with chemical shift-selective inversion-recovery fat saturation) and sagittal, post-contrast fast spin-echo T_2-weighted scans. The degree of agreement between MRI and pathology was assessed using the limits of agreement (LOAs) method of Bland and Altman [3] and statistical significance was assessed by calculating 95% confidence intervals (using t and chi-square distributions for means and variances respectively).

Results: One hundred and eight cases were identified. In the eight cases of complete pathological response (pCR) MRI had a true positive rate of 25% and a false negative rate of 75% with a corresponding error range of 6 to 40 mm (14 mm median). All other results are given the table. None of the LOAs were significantly different from each other within the sub-sets, possibly because of the small number of cases in many of the sub-sub-sets, therefore it was appropriate to analyse the data-set as a whole.

Condition (N)	MRI false positive pCR; N (%): error range / median, mm	Mean / SD of differences, mm (N)	Limits of agreement, mm
NAC +taxanes (102)			
NAC –taxanes (5)			Too small to test
IDC (74)	9 (12%): –7 to –38 / –18	–6.22 * / 21.72 (65)	–48.8 to 36.4
ILC (13)	3 (23%): –25 to –44 / –41	–7.90 / 27.57 (10)	–61.9 to 46.1
DCIS (6)	1 (17%): –8	+8.10 / 23.30 (5)	–37.6 to 53.8
InvCa Grade 1 (9)	1 (11%): –35	–2.25 / 11.71 (8)	–25.2 to 20.7
InvCa Grade 2 (47)	6 (13%): –7 to –44 / –28	–7.07 * / 21.04 (41)	–48.3 to 34.2
InvCa Grade 3 (33)	5 (15%): –7 to –38 / –18	–7.02 / 25.51 (28)	–57.0 to 43.0
InvCa ER/PR -/- (20)	3 (15%): –18 to –38 / –30	–3.85 / 27.33 (17)	–57.4 to 49.7
InvCa ER/PR +/- (21)	3 (14%): –7 to –44 / –20	–5.89 / 23.19 (18)	–51.3 to 39.6
InvCa ER/PR+/+ (50)	6 (12%): –7 to –41 / –19	–6.86 * / 19.46 (44)	–45.0 to 31.3
InvCa Her2 0/1 (68)	11 (16%): –7 to –44 / –25	–4.32 / 19.36 (57)	–42.3 to 33.6
InvCa Her2 2 (10)	0 (0%):	–6.30 / 25.48 (10)	–56.2 to 43.6
InvCa Her2 3 (10)	1 (10%): –20	–16.78 / 33.36 (9)	–82.2 to 48.6
Ca + DCIS (21)	1 (5%): –20	–7.58 / 16.53 (20)	–40.0 to 24.8
Ca – DCIS (73)	11 (15%): –7 to –44 / –25	–5.00 / 23.22 (62)	–50.5 to 40.5
All tumours (100)	13 (13%): –7 to –44 / –20	–4.84 * / 21.89 (87)	–47.8 to 38.1

Notes: IDC = invasive ductal carcinoma; ILC = invasive lobular carcinoma; DCIS = ductal carcinoma *in situ*; InvCa = invasive cancer; Ca = cancer; * = statistically significant at the 95% level.

Conclusion: CE-MRI, with reference to dynamic CE-MRI and T_2-weighted scans, demonstrates a low false complete response rate (13%), a small bias (–4.84 mm on average) but quite large LOAs (95% of differences lying between 38.1 and –47.8 mm) when compared to pathology, thus lending more credibility to its clinical utility in breast NAC cases.

References: 1. Turnbull LW. *NMR Biomed*. 22(1), 28-39 (2009). 2. Bhattacharyya M., *et al. Br. J. Cancer* 98(2), 289-293 (2008). 3. Bland JM & Altman DG. *Int J Epidemiol*. 24(Suppl 1) S7-14 (1995).