Morphologic and dynamic differences between invasive ductal and invasive lobular carcinomas of the breast

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Background: Breast MRI is becoming an important modality for initial tumor detection. Therefore, it is important to obtain a thorough knowledge of the differences in presentation observed in common tumors.

Purpose: Although recent studies have shown that the sensitivity of breast MRI for invasive lobular carcinomas (ILC) (which comprise approximately 15% of all breast malignancies) is equal to its sensitivity for ductal carcinomas (IDC), most of these studies are retrospective in nature and performed by expert radiologists[1]. It has often been reported that ILC is more difficult to assess than IDC. This study aims to quantify differences in morphology and enhancement pattern between these entities.

Materials and Methods: We retrospectively analyzed all patients who had surgery for IDC or ILC at this hospital between 2003 and 2006. All patients who underwent breast MRI prior to surgery were included. The MRI protocol used in these patients is a hybrid protocol which incorporates 22 ultrafast turboflash acquisitions (TR/TE 72/1.54, FA 20, FOV 340, matrix 256 *82, slice thickness 4.5, orientation transversal) immediately after the administration of the contrast bolus (0.2 mmol/kg Dotarem, Guerbet, France). These sequences cover the first part of the enhancement curve and are subsequently used for pharmacokinetic modeling using a Tofts model, resulting in the quantitative contrast enhancement parameters K^{trans} (permeability) and v_e (relative fraction of extravascular extracellular space ('leakage space')). These sequences were analyzed on an in-house developed, dedicated workstation[2]. A wide ROI was drawn around the whole tumor area as extracted from the pathology report and K^{trans} and v_e values were calculated for all pixels exhibiting at least 10% enhancement. Prior to the administration of the contrast bolus (once) and after the ultrafast sequences (four times) high spatial resolution FLASH 3D sequences (TR/TE 7.8/4, FA 20, rectangular FOV 340, matrix 256*256, slice thickness 1.3, orientation coronal) were acquired. Two experienced readers evaluated morphological and enhancement features using subtraction images and the relative enhancement versus time curves on a commercially available dedicated breast MR working station (CADstream, Confirma). The dominant lesion was selected, automatically segmented and further evaluated, using the quantified distribution of enhancement curves provided by this working station. Rapid initial enhancement was defined as an increase of at least 100% from the first to the second FLASH 3D acquisition, medium enhancement denotes at least 50% increase. Continuous enhancement was defined as at least 10% increase in signal intensity after the second scan, whereas wash-out was defined as at least 10% decrease.

Results: We included 136 patients, 33 with ILC and 103 with IDC. ILC were masslike in 25/33 cases, IDC in 86/103 cases (p = 0.32). Non-masslike enhancement was seen in 10/33 ILC and in 19/103 IDC (p=0.15). Additional foci of enhancement were seen in 31/33 ILC and 95/103 IDC (p=0.75). Overall reader agreement was moderate for all tumors and was not significantly different for ILC and IDC (overall $\kappa = 0.41$, ILC $\kappa = 0.40$, IDC $\kappa = 0.42$). Although, according to pathology, ILC are more often multifocal than IDC (20/33 vs 40/103, p = 0.03), this was not apparent from the evaluation of the MR images. Multifocality was seen in 19/33 ILC and 46/103 IDC (p=0.20), there was a fair agreement with pathological analysis ($\kappa = 0.39$). The automatically detected peak amplitude of relative enhancement was not significantly different for ILC and IDC (360 vs 382%, p=0.6). Visual assessment of the enhancement curve showed that wash-out was more common in IDC (87/103 vs 16/33, p<0.01), however, this difference disappeared when using automated analysis (97/103 IDC and 29/33 ILC showed wash-out in at least one voxel, p = 0.23).
Nevertheless, the distribution of relative enhancement is significantly different between these tumor types. 21/33 ILC showed wash-out in less than 10% of voxels, whereas this was seen in only 31/103 IDC (p < 0.01). Moreover, the fraction of the dominant lesion that showed continuous enhancement was also larger in ILC (61 vs 51%, p =0.03).
The pharmacokinetic analysis reflects these results. We did not observe any significant differences in v_e which corresponds to the equality of peak amplitude. Peak and mean K^{trans}, on the other hand, were significantly higher in IDC than in ILC (peak: 2.8 vs 1.9/min, p <0.01, mean: 1.2 vs 0.9/min, p = 0.01), corresponding to the differences in curve distribution.

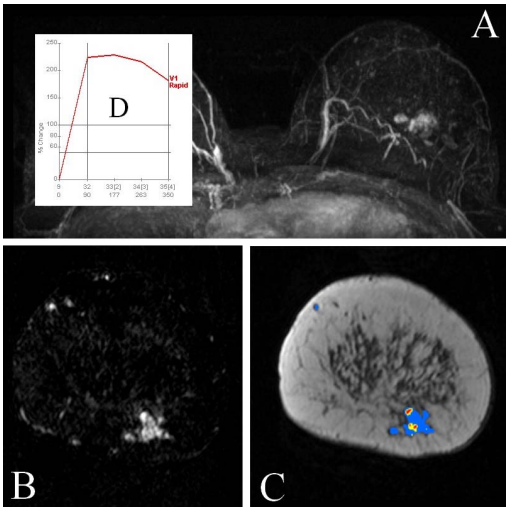

Fig 1: Patiënt with a mulitfocal ILC in the right breast. A: Maximum intensity projection B: Subtracted image of pre- and postcontrast FLASH 3D acquisitions, allowing evaluation of lesion morphology. C: FLASH 3D image with a color coded overlay of relative enhancement, note the large portion colored blue (continuous enhancement) D: Relative enhancement vs time curve, still showing wash-out

Conclusion: We did not observe significant differences in the morphology of ILC versus IDC. Automatic detection of the most malignant looking voxel does also dissolve the apparent differences in enhancement characteristics. However, ILC and IDC differ in the distribution of enhancement characteristics. In general ILC exhibit less wash-out and have a larger continuous enhancing area, which is caused by a substantially lower permeability of the blood vessels in ILC. When looking at these tumors it is essential to keep this difference in mind, because otherwise only the most malignant looking area of the tumor will be evaluated.

References:

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