STIR versus SPAIR in Breast Imaging: a Case-Based Discussion

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Purpose
The purpose of this article is to illustrate the varying appearances of breast cysts for different inversion recovery imaging sequences such as STIR and SPAIR.

Introduction
Standard breast MR protocols, e.g. for screening of high-risk patients, encompass methods for water-lipid separation [1]. To optimally assess the water component in fibroglandular tissue, fat suppression scans based on T1 relaxation values are commonly used, namely STIR (short TI inversion recovery) (Fig. 1A) or SPAIR (spectral selection attenuated inversion recovery) (Fig. 1B). Both sequences embody an inversion recovery scheme and acquire the image data after a time delay (called inversion time Ti) when the longitudinal magnetization of the signal from lipids is zero.

What is the difference between STIR and SPAIR?
The inversion-recovery (IR) technique STIR is chemically non-selective, but spatially selective, i.e. the inversion pulse affects all tissues, but only for the respective slice. SPAIR in contrast is chemically selective, but spatially non-selective, i.e. only the fatty tissue is inverted, but this applies to the whole volume of all slices. Consequently, the frequency of inversion pulses for each slice is much higher for SPAIR (TR/num-

What are the strengths and weaknesses of STIR and SPAIR?
A significant but detrimental feature of STIR is that the water signal follows the same scheme of inversion recovery although it has a different T1 value. This leads to an intrinsically low signal-to-noise ratio as opposed to SPAIR which leaves the water signal undisturbed. We illustrate this with the following case of breast cysts with short T1.

Pictorial illustration
A 49-year-old patient was selected for high-risk screening in MRI. No prior mammogram or ultrasound of the breasts was performed for the patient. Physical examination found no palpable mass in either breast. MRI was performed on a 3T scanner (MAGNETOM Verio, Siemens Erlangen, Germany). The system was equipped with an open 8-channel breast array coil. The examination protocol consisted of three steps. The first involved STIR/SPAIR. In the second step, dynamic contrast-media enhanced 3D T1-weighted gradient echo images were collected. MRI of the breasts demonstrated two circumscribed oval masses at the 12 o’clock position in the left breast. These two oval masses were isointense to hypointense on the STIR images (Fig. 2A), but hyperintense on SPAIR images (Fig. 2B). Figure 2C shows a pre-contrast T1-weighted image for reference. In the axial subtracted images, these oval masses demonstrated rim enhancement. They probably represent inflamed cysts containing proteinaceous fluid or cysts complicated by hemorrhage.

Discussion
Simple breast cysts are round or oval with sharp margins. Simple cysts have very high T2 signal and display no inter-

How do T1 changes affect the STIR image contrast?
Any other tissue with a T1 similar to that of lipids then also appears strongly attenuated (Fig 1A). This inconsistency may confuse the unwary when looking at the same tissue in a different way, e.g. on T1-weighted MRI.

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References