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Title: MRI texture analysis enhances the visibility of cortical tubers in tuberous sclerosis

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RATIONALE: Cortical tubers (CT) are the most frequent epileptogenic lesions in tuberous sclerosis (TS). CT may go unrecognized by standard radiological analysis due to the lack of signal

abnormalities on T2-weighted images, their subtlety and the complexity of brain folding patterns. We previously demonstrated that computational models based on texture analysis increases the sensitivity of conventional T1-weighted MRI for the detection of subtle dysplastic lesions by 30% (Bernasconi, 2001). Our objective here was to assess the performance of MRI texture analysis as diagnostic test in TS.

METHODS: We studied 5 TS patients (mean age: 27; two males). All had 3D T1-weighted (FFE sequence, 1mm3 isotropic voxels), proton-density (PD), T2-weighted, and FLAIR images (thickness 3-5mm). To model cortical thickness, blurring of the GM/WM transition and hyperintense signal, we used our previously developed method (Bernasconi, 2001) based on a set of voxel-wise operators applied to 3D T1-weighted MRI and resulting in a 3D map for each feature. To maximize visibility, the three maps were combined into a composite map. Conventional images and texture maps were co-registered in a common stereotaxic space. Conventional MRIs were presented in random order to two independent observers who labeled each CT. A CT was considered to have been detected only if found by both observers. Disagreement was resolved by consensus. A consensus label was created for each conventional MRI modality. A final consensus including all conventional modalities was created and presented concomitantly to the composite texture map.

RESULTS: A total number of 32 CT were identified on T1-weighted MRI. The number of CT increased to 79 on T2-MRIs (T2, PD and FLAIR combined), yielding an increase of 146%. All but one CTs seen on T1-MRI were seen on FLAIR. By using the composite texture map concomitantly with the conventional MRIs, further 35 CT were seen, yielding an additional increase of 44%. All lesions seen on the texture maps were overlooked on the initial evaluation of FLAIR images most likely because of their small size. 25% of tubers were bilateral mirror lesions, i.e. located in the same gyrus in both hemispheres.

CONCLUSION: MRI texture analysis of T1-weighetd MRI enhances the visibility of small cortical lesions in TS that may be overlooked by conventional MR imaging. This method is a useful adjunct to T2-weighted images, particularly FLAIR sequences.

Patient	Consensus-T1	Consensus-T2s	% increase adding T2s	Total CT (T1+T2s)	Additional CT on texture	% increase adding Texture
1	2	4	100%	4	3	7/4 (75%)
2	2	7	250%	7	0	7/7 (0%)
3	11	33	200%	33	6	39/33 (18%)
4	10	22	120%	22	13	35/22 (59%)
5	7	13	85%	14	13	27/14 (93%)
Total	32	79		80	35	115/80
Mean			146%			44%

CT: cortical tubers

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