FRACTIONAL ANISOTROPY IN DIFFUSION TENSOR IMAGING AND DIFFUSION KURTOSIS IMAGING AT 3-T MR FOR DETECTION OF PATIENTS WITH DEPRESSION AND COMORBID HYPERTENSION IN DEPRESSION

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Purpose:

Depression is a common psychological disorder. The prevalence of clinically significant depressive syndromes are on the rise. The performance of patients with depression and comorbid hypertension in depression are different, but the mechanism is uncertain. Diffusion tensor imaging (DTI) is a noninvasive method to investigate the differences of white matter impairment. Fractional anisotropy is a very important parameter of DTI. Diffusion kurtosis imaging(DKI) is a clinically feasible extension of diffusion tensor imaging that probes restricted water diffusion in biological tissues[1]. Being an extension of DTI, DKI provides conventional DTI-based parameters, such as the FA, and unique parameters that describe the degree to which the water diffusion is non-Gaussian [2]. Fractional anisotropy of kurtosis (FA_k) is similar to FA in DTI, the anisotropy of directional kurtosis can be conveniently defined as FA_k. The aim of this study is to evaluate the differences between depression and comorbid hypertension in depression using FA of DTI and FA_k of DKI.

Material and Method:

Patients with depression (n=15, 3men and 12women, age range 34-68 years, mean age 57.3±8.93 years) , comorbid hypertension in depression (n=22, 2men and 20women, age range 42-73 years, mean age 61.2±6.82 years), hypertension(n=28, 7men and 21women, age range 40-78 years, mean age 59.2±7.53 years) and healthy control subjects(HC, n=20, 4men and 16women, age range 33-68 years, mean age 56.3±8.52 years)were recruited. All MRI examinations were performed using a 3.0T scanner. DTI and DKI scanning were conducted with 45 images acquired on a GE750 3T scanner. The acquisition parameters were as following: DTI[TR=8000ms; TE= 82.9ms; slice thickness 3 mm; field of view (FOV) 24×24 cm; matrix 128×128, voxel size= 2×2×4 mm^3,diffusion directions 25, *b* value 0,1000 s/mm^2, scan time 7min4sec]. DKI [TR=8000ms; TE= 93.5ms; slice thickness 3 mm; field of view (FOV) 24×24 cm; matrix 128×128, voxel size= 2×2×4 mm^3, diffusion directions 31, *b* value 0,1000,2000s/mm^2, scan time 8min40sec]. Voxel-based analysis was used to analyze DTI data (SPM8, DTI studio) and DKI data(SPM8, DKE). FA in patients with depression, comorbid hypertension in depression and hypertension were compared with HC respectively. FA_k was processed in the same way.

Results:

Compared to HC, we found significant decrease in FA_k of patients with depression in bilateral cerebelum, bilateral inferior temporal gyri, middle and inferior occipital gyri, rectus gyri, insula, fusiform gyri, thalamus, cingulum gyri, left middle and superior temporal gyri, middle frontal gyrus ,precuneus.(p<0.001, F=11.65, uncorrected for multiple comparisons; cluster size>50) (Fig1,4,Table1). Compared to HC, there were more cerebral regions of individuals with comorbid hypertension in depression involved according to the significant decrease in FA_k in bilateral cerebelum, inferior temporal gyri, hippocampus, parahippocampal, putamen, fusiform gyri, left superior frontal gyrum, cuneus, thalamus , right anterior and middle cingulum , pallidum and amygdala.(p<0.001, F=11.65, uncorrected for multiple comparisons; cluster size>50) (Fig 2,3). Compared to HC, we found decrease in FA of patients with comorbid hypertension in depression in bilateral thalumus, left middle temporal gyri, middle frontal gyrus, insula, right caudate.(p<0.001, F=11.65, uncorrected for multiple comparisons; cluster size>50)(Fig 5). Compared to HC,there were slight decreased in FA of patients with depression but the voxel were below50.

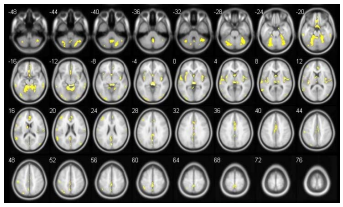

Fig1 DKI. Depression vs HC.

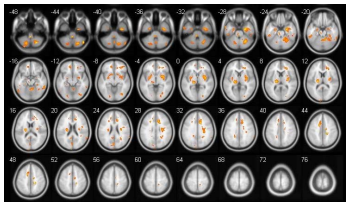

Fig 2 DKI. Comorbid hypertension in depression vs HC.

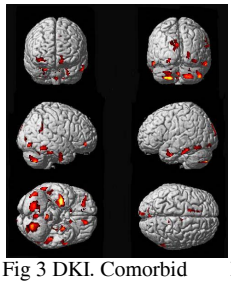

Fig 3 DKI. Comorbid hypertension in depression vs HC.

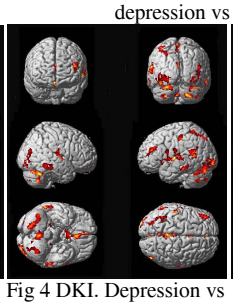

Fig 4 DKI. Depression vs HC

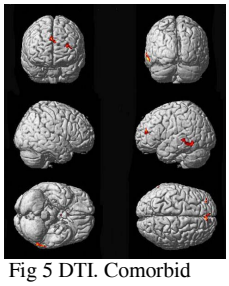

Fig 5 DTI. Comorbid hypertension in depression vs HC.

Table 1 Cerebral areas involved in comorbid hypertension in depression with DKI

Cerebral areas	MNI X	MNI Y	MNI Z	voxel
Left cerebelum	-50	-60	-48	526
Right cerebelum	48	-64	-46	911
Left superior frontal gyrus	-34	8	48	74
Right inferior temporal gyrus	60	-46	-16	110
Left inferior temporal gyrus	-56	-40	-22	140
Left hippocampus gyrus	-24	-8	-26	63
Right hippocampus	26	-8	-26	98
Left thalamus	-20	-20	10	244
Left putamen	-30	-2	-2	237
Right putamen	30	-12	8	459
Left parahippocampal gyrus	-26	-2	-36	88
Left cuneus	-2	-80	24	108
Right parahippocampal gyrus	24	-10	-26	205
Right fusiform gyrus	34	-8	-40	198
Right middle cingulum gyrus	18	-34	48	174
Right anterior cingulum gyrus	10	24	28	182

Conclusions:

FA is a good index to detect depression. FA_k of DKI may serve as a more sensitive tool to detect and characterize subtle changes. Our results reveal underlying extensive white matter impairments in patients with depression and comorbid hypertension in depression. The different patterns of decrease in FA suggest hypertension may play a synergistic action in the progress of depression.

References:

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