MRI diffusion histogram analysis in paediatric optic pathway tumours with and without neurofibromatosis

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Introduction

Optic Pathway Gliomas (OPG) are benign tumours (low-grade astrocytoma) that have an unpredictable course. Previous studies have suggested that OPGs, which associated with neurofibromatosis type 1 (NF1), comprise a radiologically-distinct group of tumours to those that are not associated with NF1 [1]. OPGs without NF1 have shown a much higher rate of progression (95%) compared to NF1-OPGs (50%) [2]. Recently, some studies have investigated the possible relation between prognosis and Mean Apparent Diffusion Coefficient (ADC) [3-4]. In this study, we investigate the relationship between various ADC-histogram based metrics and NF1 presence.

Methods

This retrospective study included 14 patients (4.0 years, range [0.6-12.6], M/F ratio 5/9) with radiologically diagnosed OPG. ADC maps were generated from pre-treatment clinical scans, from 3 scanners in 2 centres (Siemens Symphony 1.5T/Philips Intera 1.5T/Philips Achieva 3T, TE = 56/66/108ms, TR = 3700/5741/2592ms, voxel dimensions 0.9x0.9x7.2/1.8x1.8x4.4/2.0x2.0x4.4/mm3, b=0 and 1000 s/mm^2). Normalised ADC maps were created by dividing ADC values by each patient's normal appearing white matter (NAWM) ADC value. Histogram analysis was carried out on in-house software. NF-1 status was defined radiologically from T2 hyper-intensities. Differences in distributions were tested in SPSS using Mann-Whitney U test.

Results

NF1 was present in 10 patients. Average tumour volume was 80 [0.5-201] cm^3. Tumour location included chiasm (14), chiasm and optic nerve (5) chiasm and tracts/radiations (4). Differences, in tumour location or volume, were not significant with respect to NF1 association. ADC histograms were created from ROIs drawn on registered T1w+Gd and T2w images. These ROIs were overlaid on registered ADC maps. ADC histogram metrics can be seen in the table below. Mean diffusivity values were 1.35±0.4x10−3 mm^2/s. There were no significant differences in ADC histogram-derived metrics between the NF1 and the non-NF1 groups. Although there was a trend for larger tumours to have lower ADC values, none of the metrics reached significance.

	ADC values (x10^{-3} mm^2/s)		Sig.	ADC ratio (norm to NAWM.)		Sig.
	NF1	Non NF1		NF1	Non NF1	
minADC	0.72	0.73	>0.05	1.1	1.1	>0.05
aveADC	1.38	1.31	>0.05	1.8	1.7	>0.05
10th perc.	0.93	0.92	>0.05	1.3	1.2	>0.05
25th perc.	1.10	1.13	>0.05	1.5	1.5	>0.05
median	1.39	1.37	>0.05	1.8	1.7	>0.05
75th perc.	1.66	1.50	>0.05	2.1	2.1	>0.05
90th perc.	2.03	1.71	>0.05	2.5	2.4	>0.05

Table 1: ADC histograms metrics for ADC maps and normalised ADC maps.

Discussion

Conventional radiological features do not correlate with tumour biological behaviour [2] or visual outcome [5]. A recent study found that average ADC was higher on tumours that eventually required treatment [3], but this conflicts with a previous larger study [4]. Although NF1 OPGs are associated with significantly better outcome, we found no significant differences in any of the ADC-histogram derived metrics between the two groups.

Conclusion

These results suggest that there are no significant differences between ADC values in NF1 associated and non-NF1 associated tumours.

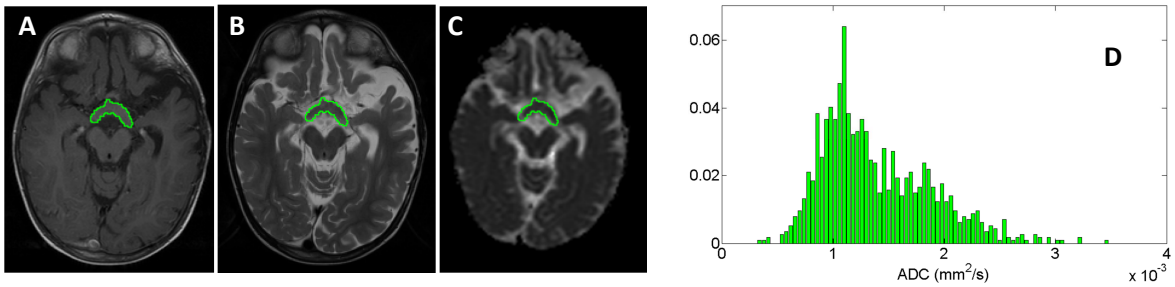

Figure 1: ADC histograms (D) were created from ROIs drawn on registered T1w+Gd (A) and T2w (B) images. The result was overlaid on registered ADC maps (C).

Acknowledgments

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