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Utilising functional imaging to predict survival in paediatric brain tumours

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Title: Utilising functional imaging to predict survival in paediatric brain tumours.

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Intro

Brain tumours are a common cause of death in the paediatric population. We have previously shown that MR imaging and spectroscopy can be used to non-invasively differentiate between tumour types. Here, we demonstrate that functional imaging can be highly predictive of survival and grade in a paediatric cohort.

Methods

Perfusion (PWI) and diffusion weighted imaging (DWI) were performed in a multi-site (Birmingham Children's Hospital, Royal Victoria Infirmary, Alder Hey, Nottingham) cohort ([grade, 5-year survival alive:dead number] = [I,15:1],[II, 5:1],[III,2:3],[IV,8:11]). ROIs were drawn on T_2 imaging and functional imaging features (mean, standard deviation, skewness, and kurtosis) were derived. Supervised machine learning was used to predict 5-year survival and tumour grade from features. ANOVA and post-hoc tests were used to assess differences in features between grade and 5-year survival status.

Results

5-year survival was predicted with 89%, 85%, and 87% accuracy with all imaging, perfusion, or diffusion features, respectively.

A significant difference in perfusion was found between surviving and diseased participants (1.71 ± 0.82 vs 2.62 ± 1 mL/100g/min, respectively, $p < 0.05$). A significant difference in ADC ($mm^2\ s^{-1}$) between tumour grades was found (1 vs 4 (1533 ± 458 vs 857 ± 239), 4 vs 3 (857 ± 239 vs 1197 ± 137), 4 vs 2 (857 ± 239 vs 1440 ± 557), corrected $p < 0.05$).

Conclusion

We have shown that perfusion and diffusion imaging features can be used to non-invasively assess tumour grade and estimate 5-year survival status in a cohort of paediatric brain tumours.