ABSTRACT

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The role of apparent diffusion coefficient histogram metrics for differentiating pediatric medulloblastoma histological variants and molecular groups.

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BACKGROUND: Medulloblastoma, a high-grade embryonal tumor, is the most common primary brain malignancy in the pediatric population. Molecular medulloblastoma groups have documented clinically and biologically relevant characteristics. Several authors have attempted to differentiate medulloblastoma molecular groups and histology variants using diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps. However, literature on the use of ADC histogram analysis in medulloblastomas is still scarce.

OBJECTIVE: This study presents data from a sizable group of pediatric patients with medulloblastoma from a single institution to determine the performance of ADC histogram metrics for differentiating medulloblastoma variants and groups based on both histological and molecular features.

MATERIALS AND METHODS: In this retrospective study, we evaluated the distribution of absolute and normalized ADC values of medulloblastomas. Tumors were manually segmented and diffusivity metrics calculated on a pixel-by-pixel basis. We calculated a variety of first-order histogram metrics from the ADC maps, including entropy, minimum, 10th percentile, 90th percentile, maximum, mean, median, skewness and kurtosis, to differentiate molecular and histological variants. ADC values of the tumors were also normalized to the bilateral cerebellar cortex and thalami. We used the Kruskal-Wallis and Mann-Whitney U tests to evaluate differences between the groups. We carried out receiver operating characteristic (ROC) curve analysis to evaluate the areas under the curves and to determine the cut-off values for differentiating tumor groups.
RESULTS: We found 65 children with confirmed histopathological diagnosis of medulloblastoma. Mean age was 8.3 ± 5.8 years, and 60% (n = 39) were male. One child was excluded because histopathological variant could not be determined. In terms of medulloblastoma variants, tumors were classified as classic (n = 47), desmoplastic/nodular (n = 9), large/cell anaplastic (n = 6) or as having extensive nodularity (n = 2). Seven other children were excluded from the study because of incomplete imaging or equivocal molecular diagnosis. Regarding medulloblastoma molecular groups, there were: wingless (WNT) group (n = 7), sonic hedgehog (SHH) group (n = 14) and non-WNT/non-SHH (n = 36). Our results showed significant differences among the molecular groups in terms of the median (P = 0.002), mean (P = 0.003) and 90th percentile (P = 0.002) ADC histogram metrics. No significant differences among the various medulloblastoma histological variants were found.

CONCLUSION: ADC histogram analysis can be implemented as a complementary tool

in the preoperative evaluation of medulloblastoma in children. This technique can provide valuable information for differentiating among medulloblastoma molecular groups. ADC histogram metrics can help predict medulloblastoma molecular classification preoperatively.

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