Differentiation between cerebral metastases, meningiomas, and primary gliomas by dynamic contrast-enhanced MRI.

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Purpose:

Conventional magnetic resonance (MR) imaging has a limited capacity to differentiate intraaxial brain masses[1,2]. The purpose of this study is to evaluate the capability of the volume transfer coefficient (K^{trans}) and the interstitial space volume fraction (v_e) derived from Reference Tissue (RR) model[3] to differentiate intraaxial brain masses.

Materials and Methods :

A total of 59 patients with pathologically confirmed intraaxial brain masses (high -grade glioma, HGG, n =5; low-grade glioma, LGG, n =6; meningiomas, n =10; cerebral metastases, n =20; brain abscess，n=3) underwent dynamic contrast-enhanced MR imaging. Images were acquired using a three-dimensional (3D) fast gradient echo sequence. K^{trans} and v_e were calculated from the DCE MRI data by RR model. Results were compared with pathologic findings. Kruskal-Wallis H test and independent T-test were used to compare differences between the 5 groups. Receiver operating characteristic curve analysis was performed for each of the variables in differentiation between LGG and HGG.

Results:

K^{trans} of 59 cases of intraaxial brain masses in the parenchyma: LGG is 0.054±0.015, HGG is 0.210±0.032, brain abscess is 0.234±0.032, cerebral metastases is 0.202±0.021, and meningiomas is 0.267±0.048. (FIG.1) It is observed that there are significant differences among the five group with Kruskal-Wallis H test (*Chi-Square =17.37，$p < 0.05$*) and significant differences exist between LGG and other four kinds of brain masses with independent T-test (*$p < 0.05$,* especially for HGG *$p < 0.01$*). The optimal cutoff value of K^{trans} for differentiating LGG from HGG is 0.072, which implies a sensitivity of 90% and a specificity of 83.3%. In contrast, the optimal cutoff value of v_e is 0.231, implying a sensitivity of 90% and a specificity of 67.7%. But there are no significant differences among HGG, brain abscess, cerebral metastases and meningiomas. However, the K^{trans} values in the peripheral edema of the HGG and brain metastasis are 0.063±0.052 and 0.010±0.007 respectively. Meanwhile, there shows a significant difference (FIG. 3) between the K^{trans} values in the peritumoral edema of HGG and cerebral metastases ($p<0.001$).

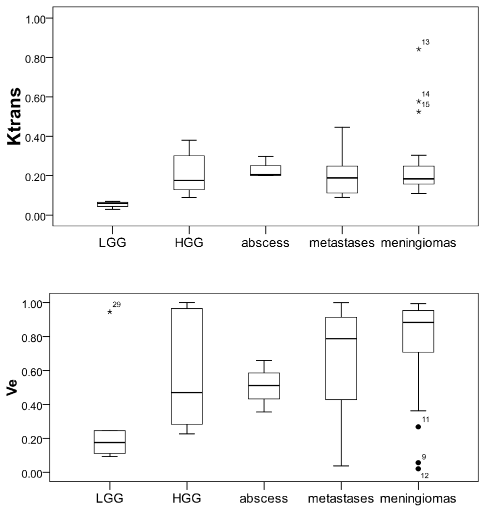

FIG. 1. Box-and-whisker plots of (a) K^{trans} and (b) v_e, obtained respectively for LGG, HGG, brain abscess, cerebral metastases and meningiomas. Symbols above plots in Fig 1(a) and (b) are outliers.

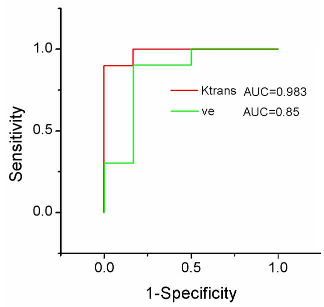

FIG. 2. Two receiver operating characteristic curves of K^{trans} and v_e for differentiation of HGG from LGG. Both K^{trans} and v_e are significant predictors of HGG with high sensitivity and specificity.

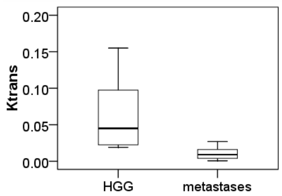

FIG. 3. Box-and-whisker plots of K^{trans} obtained respectively for peritumoral edema of HGG and cerebral metastases ($p<0.001$).

Conclusions:

K^{trans} and v_e derived from RR model are promising diagnosis indexes that are valuable in differentiating LGG, HGG, and metastases. Accordingly, those useful functional parameters could serve as potential markers for distinguishing intraaxial brain masses.

References:

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[3] Thomas E, et al. Magn Reso Imag 2005; 23:519–529.