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Analysis of the clinical display effect of imaging techniques on the staging of gliomas

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Abstract. Glioma is a primary intracranial malignant tumor, which is difficult to be cured and has the characteristics of easy recurrence and high mortality rate, therefore, it is of great clinical significance to accurately grade glioma before operation. Since biopsy of gliomas is relatively difficult and its accuracy cannot be guaranteed, imaging examination has become an important means of clinical grading of gliomas. This paper, through the literature analysis method, reviews the previous studies of applying imaging methods to grade gliomas in China and abroad and summarizes the main techniques of MRI and CT and their grading effects. Finally, this paper finds that MRI and CT can be used to grade gliomas alone, but both have limitations, while the combined application of MRI and CT has high sensitivity and specificity for the diagnosis and grading of gliomas, which makes up for their respective shortcomings, and is worthy of wide application.

Keywords: Gliomas, Magnetic Resonance Imaging, Computed Tomography.

1. Introduction

Gliomas are a group of malignant intracranial tumors that occur mostly in the central nervous system and account for approximately 50% of all brain tumor patients [1-2]. According to clinical grading, gliomas are classified into grades I to IV, and their clinical manifestations are closely related to the site of occurrence and the size of the tumor. Grades I and II are low-grade gliomas, while grades III and IV are high-grade gliomas. Treatment options for gliomas vary with different grades, and accurate grading is clinically important for planning treatment and improving prognosis. Gliomas are typically heterogeneous, and thus histologic samples obtained at biopsy may be subject to sampling error, and intracranial biopsy is relatively difficult [3]. Therefore, it is often graded using imaging techniques. This paper discusses the image characteristics of Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) techniques to determine their value in the staging of gliomas. This paper reviews previous studies in China and abroad that applied imaging methods to apply grading to gliomas and summarizes the main techniques of MRI and CT and their clinical effects by using the literature analysis method. This study organizes the current stage of medical imaging technology in the field of glioma grading as well as the latest progress and trends, which can give some references for Related researchers.

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2. Imaging Grading of Gliomas

2.1. Gliomas on MRI

MRI is an important imaging technique for the clinical diagnosis of gliomas, and several sequences of MRI such as Diffusion Weighted Imaging (DWI) and Perfusion Weighted Imaging (PWI) can be applied in the grading diagnosis of gliomas. DWI is able to detect the diffusive movement of water molecules in tissues, which can be responded to by measuring the Approximate Diffusion Coefficient (ADC). Some studies have shown that, due to the high cytoplasmic nature of the tumor, high-grade gliomas tend to exhibit lower ADC (see Figure 1) [4]. PWI is the use of rapid enhancement scanning to determine perfusion by contrast signal intensity. High-grade gliomas will show aggressive growth, so the higher the grade of the glioma, the greater the proliferation of blood vessels [5]. Wang et al used the parameter Relative Cerebral Blood Volume (RCBV) in PWI as an observational indicator, it can be seen that in the parenchymal region of the tumor, the RCBV of low-grade gliomas was significantly lower than that of high-grade gliomas [6]; in the edematous region surrounding the tumor, the RCBV of low-grade gliomas was significantly lower than that of high-grade gliomas.

This shows that MRI is effective in preoperative grading of gliomas.

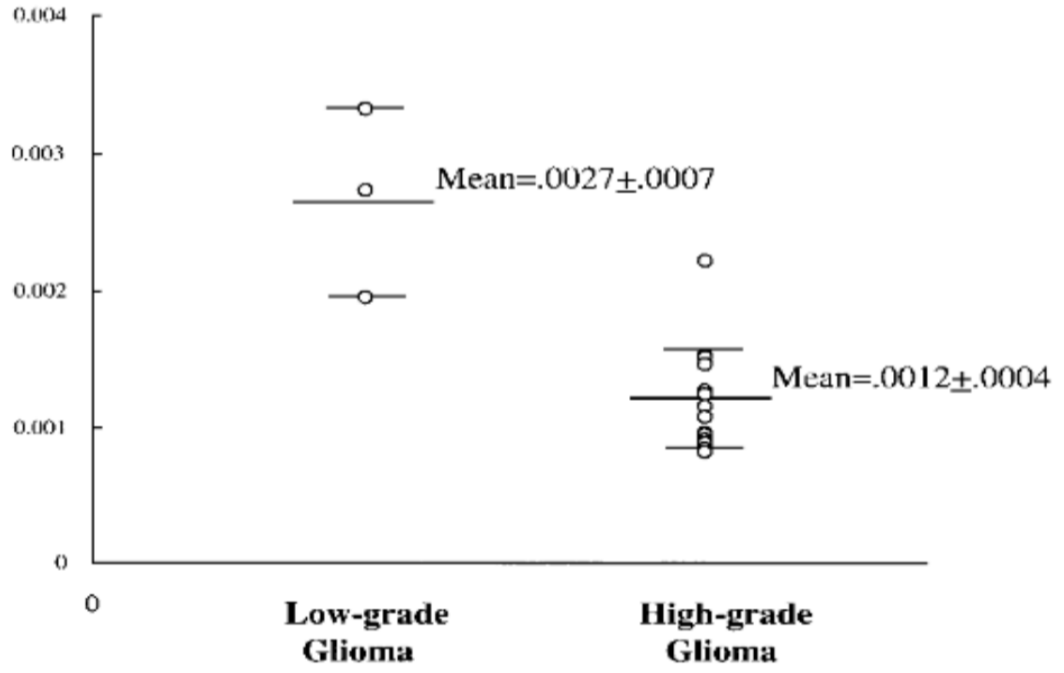

Figure 1. Apparent diffusion coefficient (ADC) value versusgrading of gliomas.

The ADC value is higher in the high-gradegliomas than in the low-grade gliomas. The difference betweenthe means is statistically significant (P,0.001) [4].

2.2. Gliomas on CT

CT is also a common imaging technique used clinically to diagnose gliomas because CT is better at showing hemorrhages and calcifications within the lesion. Among them, multilayer spiral CT perfusion imaging has high temporal resolution, spatial resolution and density resolution, which can effectively detect the functional status of brain tissue, so it can be used for diagnosis and grading of gliomas in the brain [7]. The main parameters of CT perfusion imaging include Blood Flow (BF), Blood Volume (BV), and surface permeability coefficient (PS). According to Zhang et al, and Liu et al,

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the higher the pathological grade, the higher the BF, BV, and PS values in the parenchymal region of gliomas, and different grades of gliomas can be distinguished based on these parameters [8-9].

3. Advantages And Disadvantages of MRI Vs. Ct

3.1. Advantages and disadvantages of MRI

MRI is radiation-free and does not cause radioactive damage to brain tissue, and it has high soft tissue resolution and obvious contrast of different tissues, which can intuitively determine the structure within the tumor, and it also has the advantages of being able to be multi-directional, multi-sequence imaging and three-dimensional imaging. However, MRI examination takes a longer time and has more contraindications (including claustrophobia, metal implants, etc.), especially unsuitable for patients with acute and critical diseases.

3.2. Advantages and disadvantages of CT

CT scanning is fast and has a wide range of indications. It has the advantage of responding to characteristic density changes such as calcifications, hemorrhages, and cystic lesions, but there are limitations in its application to diffusely growing tumors like gliomas, which may be subject to errors due to changes in normal anatomy caused by bands of edema and compression by the tumor [10]. In addition, CT examinations can be compromised by ionizing radiation.

4. Combination of MRI and CT

Currently, clinical diagnosis and grading of gliomas are mainly performed by MRI and CT, but the validity of the imaging methods is still controversial. In summary, it can be seen that MRI and CT are not mutually exclusive techniques per se, and they can be used synergistically to further diagnose gliomas. According to existing studies, the combined use of CT and MRI techniques can provide complementary information to more accurately determine the extent of the tumor, the demarcation from normal tissue, and the precise structures and alterations within the tumor. According to Wu, the diagnostic ability of patients using CT combined with MRI was better than that of CT alone or MRI alone, and the sensitivity and specificity of the combined application were relatively high, reaching 97% and 100%[11]; according to Long et al, the diagnostic sensitivity of CT alone for the diagnosis of gliomas (80.00%), and the specificity of MRI alone for the diagnosis of gliomas (82.22%) were significantly lower than that of CT combined with MRI ($P < 0.05$), and the diagnostic value for gliomas was significantly lower than that of CT combined with MRI ($P < 0.05$) [12].

5. Conclusion

This paper found that both MRI and CT have techniques that can be used individually to grade gliomas with good results, while the combined application of MRI and CT has high sensitivity and specificity for the diagnosis and grading of gliomas, and deserves to be widely used in clinical practice. There is some room for improvement in this paper: a. This paper does not discuss all imaging techniques that can be used to grade gliomas, and only roughly summarizes popular and commonly used techniques; b. Most of the literature included are retrospective studies, the current status of the subjects is unknown, and a certain number of prospective studies are needed to more accurately validate the reliability and usefulness of the imaging methods in clinical practice. Future studies could focus on the combination of multiple imaging techniques for glioma grading to improve the speed of examination and diagnostic quality.

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