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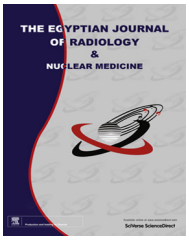

ORIGINAL ARTICLE

A potential role of CT perfusion parameters in grading of brain gliomas☆

Rania Maarouf, Hossam Sakr *

Radiology Department, Ain Shams University, Cairo, Egypt

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KEYWORDS

CT perfusion;
Glioma grading;
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Abstract *Background and purpose:* Gliomas are very heterogeneous tumors, glioma grading is currently based on the histologic assessment. With noninvasive measurement of vascular permeability by CT Perfusion (CTP) multiple perfusion parameters which can be obtained with a single acquisition the aim of this study was to find the most sensitive and specific CTP parameters and their cutoffs that can be used to differentiate between low and high grade brain gliomas.
Material and methods: Twenty-five patients were included in this study divided into two groups: group A includes 15 patients with high grade glioma, group B includes 10 patients with low grade glioma; CTP was done for all patients, perfusion values of tumors were then calculated, and statistical analysis was done using IBM SPSS.
Results: A statistically highly significant difference was found between the two groups regarding the BF, BV and PS with *P* values of 0.0003, 0.00026 and 0.0009 respectively. The two groups were found to be self-discriminated by BV and PS with sensitivity of 95% and 86% respectively.
Conclusion: CTP shows high sensitivity in terms of differentiation between high and low grade adult gliomas.

1. Introduction

The most common primary brain neoplasms in adults are gliomas which are very heterogeneous tumors (1). Highly vascular ones are called high-grade gliomas, so, histopathological analysis is used in glioma grading (2), and stereotactic brain biopsy or cytoreductive surgery is the only way to obtain material for histopathological assessment (3); yet they have inherent limitations in their techniques and interpretation (4). Treatment strategies, prognosis and response to therapy depend on accurate grading, so it is important to choose the most representative part of the tumor to be biopsied, and the two most important factors in determining the malignancy of gliomas are infiltration of the nearby brain parenchyma and neoangiogenesis (5).

Areas of postcontrast enhancement in the conventional MRI indicate disrupted or absent blood brain barrier and not necessarily neovascularity of the tumoral lesion (6).

☆ This research was done at: Ain Shams University Specialized Hospital, Al Khalifa Al Maamoun Street, Abbassia, Cairo 11381, Egypt.

* Corresponding author at: 9510 Adly El Melegy Street, Mokattam, Cairo 11751, Egypt. Tel.: +20 1001930723.
E-mail address: drhossamsakr@yahoo.com (H. Sakr).

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Table 1 Comparison between the two groups regarding the median CT perfusion parameters.

Group	I (high grade)	II (low grade)
BF	92.5 (90.5–94.5)	19.8 (17.8–21.8)
BV	6.4 (4.4–8.4)	2.9 (0.9–4.9)
PS	6.8 (4.8–8.8)	3.2 (1.2–5.2)

Various techniques used to measure tumor perfusion parameters in vivo resulting in more accurate grading of gliomas, asses their prognosis and response to therapy avoiding some of the limitations of both histologic grading and conventional morphologic imaging (7).

Various MR perfusion techniques have been used to asses brain gliomas to estimate tumor blood volume, blood flow and permeability; however, tissue attenuation measured by CT Perfusion (CTP) has a linear correlation with tissue concentration of a contrast agent, unlike perfusion MR imaging, so it probably provides a more accurate assessment of hemodynamic (tumor blood volume) and physiologic (tumor vascular leakiness) parameters. Other advantages of CTP include wide availability, short scan time, and relatively low cost as compared to MR perfusion, and CTP is likely well-suited to study brain gliomas and may be used as a widely available, easy and accurate imaging technique for assessment of perfusion parameters and their use as imaging biomarkers (3,5).

Thus the purpose of this study was to assess the role of CTP in the grading of adult brain gliomas.

2. Materials and methods

2.1. Study population

This study was carried out between September 2012 and December 2014, the institutional ethics committee approved this study and waived informed consent. All data were reviewed prospectively.

Inclusion criteria were (a) age between 20 and 70 years. (b) Both sexes were included. (c) The presence of brain glioma diagnosed by conventional and contrast enhanced MRI.

Exclusion criteria were (a) lactating and pregnant females whatever the gestational age (serum pregnancy test was done for all premenopausal female patients) and (b) Patients with impaired renal function (serum creatinine level higher than 1.3 mg/100 ml).

The population enrolled in this study was composed of 25 patients diagnosed as having brain glioma by conventional and contrast enhanced MRI, and they were further categorized into 2 groups as follows:

Group A (patients with high grade tumor by histopathology) includes 15 patients (10 males and 5 females), aged between 43 and 67 years, median age of 54 years.

Group B (patients with low grade tumor by histopathology) includes 10 patients (5 males and 5 females), aged between 28 and 60 years, median age of 44 years.

Thus, the total number of males in the study was 15, and total number of females was 10.

2.2. Acquisition of CTP images

All patients were required to provide written informed consent before study participation.

A second-generation 128-slice dual-source CT in dual-energy mode (Somatom Definition Flash, Siemens Healthcare, Forchheim, Germany) was used; pre-contrast axial cuts were taken during a breath hold at the end of inspiration. The coverage area starts from the level of the top of the skull vault till skull base. After tumor localization, a 2 cm lesion region was selected based on the pre-contrast series for the dynamic study in the maximal diameter of the tumor. A dynamic study of the selected area was performed in a single

Table 2 The results of Wilcoxon Rank Sum test for groups A and B (HS = highly significant, NS = non significant).

	BF	BV	PS
P	0.0003	0.00026	0.0009
Sig.	HS	HS	HS

Table 3 The results of Wilcoxon Rank Sum test for groups I and contralateral normal brain (HS = highly significant, S = significant, NS = non significant):

	BF	BV	PS
P	0.010515	0.007428	0.02047
Sig.	S	HS	S

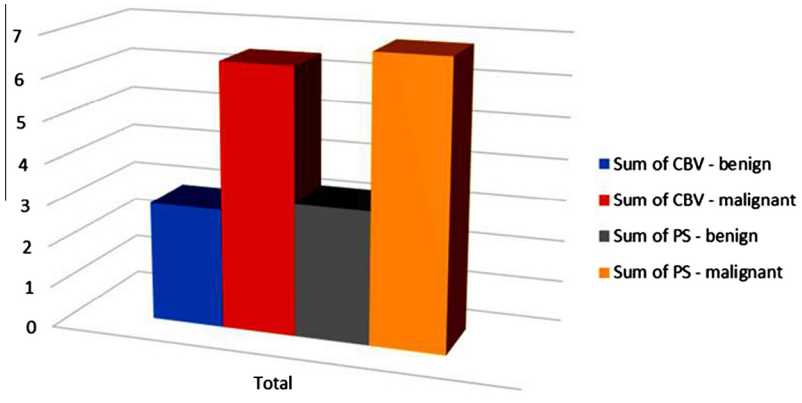

Fig. 1 Comparison between the two groups regarding the median BV and PS.