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Prognostic value of brain perfusion by MRI in the initial study of high grade gliomas

Valor pronóstico de la perfusión cerebral por RM en el estudio inicial de los gliomas de alto grado

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Abstract

Objectives

To evaluate if the tumour perfusion at the initial MRI scan is a marker of prognosis for survival in patients diagnosed with High Grade Gliomas (HGG). To analyse the risk factors which influence on the mortality from HGG to quantify the overall survival to be expected in patients.

Patients and methods

The patients diagnosed with HGG through a MRI scan in a third-level hospital between 2017 and 2019 were selected. Clinical and tumour variables were collected. The survival analysis was used to determine the association between the tumour perfusion and the survival time. The relation between the collected variables and the survival period was assessed through Wald's statistical method, measuring the relationship via Cox's regression model. Finally, the type of relationship that exists between the tumour perfusion and the survival was analysed through the Lineal Regression method.Those statistical analysis were carried out using the software SPSS v.17.

Results

38 patients were included (average age: 61.1 years old). The general average survival period was 20.6 months. A relationship between the tumour perfusion at the MRI scan and the overall survival has been identified, in detail, a group with intratumor values of relative cerebral blood volume (rCBV)>3.0 has shown a significant decline in the average survival period with regard to the average survival period of the group with values <3.0 (14.6 months vs. 22.8 months, p=0.046). It has also been proved that variables like Karnofsky's scale and the response time since the intervention significantly influence on the survival period.

Conclusions

It has become evident that the tumour perfusion via MRI scan has a prognostic value in the initial analysis of HGG. The average survival period of patients with rCBV less than or equal to 3.0 is significantly higher than those patients whose values are higher, which allows to be more precise with the prognosis of each patient.

Resumen

Objetivos

Valorar si la perfusión tumoral en el estudio diagnóstico inicial de RM es un marcador pronóstico para la supervivencia en pacientes diagnosticados de gliomas de alto grado. Analizar los factores de riesgo que influyen en la mortalidad por gliomas de alto grado para poder cuantificar la supervivencia global esperada del paciente.

Pacientes y métodos

Se seleccionaron las RM de todos los pacientes diagnosticados de glioma de alto grado en un hospital de tercer nivel entre los años 2017 y 2019. Se recogieron variables clínicas y tumorales. Se usó el análisis de supervivencia para determinar la asociación entre la perfusión tumoral y el tiempo de supervivencia. Se estudió la relación entre las variables recogidas y la supervivencia mediante el estadístico de Wald, cuantificando esta relación mediante la Regresión de Cox. Por último, se analizó el tipo de relación existente entre la perfusión tumoral y la supervivencia a través del estudio de Regresión Lineal. Estos análisis estadísticos se realizaron con el software SPSS v.17.

Resultados

Se incluyeron 38 pacientes (media de edad 61,1 años). La supervivencia media global fue de 20,6 meses. Se observó asociación entre la perfusión tumoral en la RM diagnóstica y la supervivencia global, mostrando el grupo con valores intratumorales de volumen sanguíneo cerebral relativo (rVSC) >3.0 una disminución significativa en el tiempo medio de supervivencia respecto al grupo con valores <3.0 (14,6 meses vs 22,8 meses, p=0,046). También han demostrado influir significativamente en la supervivencia media variables como la escala de Karfnosky y el tiempo de recidiva desde la intervención.

Conclusiones

Se ha evidenciado que la perfusión tumoral por RM tiene valor pronóstico en el estudio inicial de los gliomas de alto grado. La media de supervivencia de los pacientes con rVSC inferior o igual a 3.0 es significativamente mayor que en aquellos cuyo valor es superior, lo que permitiría una aproximación pronóstica más precisa en cada paciente en el momento del diagnóstico.

Introduction

High-grade gliomas (WHO grades III and IV) are the most common malignant brain tumours among adults. Grade IV gliomas have a particularly poor prognosis. The median survival for patients with these gliomas is around 15 months from time of diagnosis. Survival at five years ranges from 5% to 10%.1, 2

Magnetic resonance imaging (MRI) is the first-choice diagnostic modality,3, 4 and has a key role in the characterisation of lesions as well as in treatment planning. Recent discussion has centred around whether MRI could predict the prognosis of this disease. Grade IV gliomas are tumours with marked neoangiogenesis,[5] and perfusion studies can provide considerable information in this regard. As a non-invasive and easily reproducible method, they provide quantitative and qualitative assessment of brain tumours. There are three main techniques used to perform MR perfusion studies: T2*-weighted dynamic susceptibility contrast (DSC), T1-weighted dynamic contrast enhanced (DCE) and Arterial Spin Labelling. T2*-weighted perfusion primarily assesses microvasculature and angiogenesis, while T1-weighted perfusion examines vascular permeability. T2*-weighted perfusion is the most commonly employed technique and the one used in our study. It has a high signal-to-noise ratio and good temporal resolution, as well as a relatively short acquisition time.[6] Some of the parameters that can be analysed include cerebral blood volume (CBV), cerebral blood flow (CBF) and mean transit time (MTT). It can also be used to obtain measurements such as relative CBV (rCBV), which is the most commonly used parameter in the assessment of brain tumours.[7]

Our hypothesis is that elevated CBV values on diagnostic MRI of high-grade gliomas correlate with a worse prognosis. To test this hypothesis, we will analyse the association between tumour perfusion at the initial diagnosis and the overall survival time of patients diagnosed with this pathology. We will also analyse risk factors caused by these tumours that influence mortality in order to estimate a patient's expected length of survival.

Section snippets

Study design and recruitment of the patient series

We conducted an observational and retrospective study with a population comprised of patients diagnosed with high-grade gliomas by MRI at our centre between 2017 and 2019. The study was approved by our hospital's ethics committee.

The database used in this study was provided by the neurosurgery department of our hospital and includes patients diagnosed with high-grade gliomas in the aforementioned period.

The inclusion criteria were: 1) adult patients aged >18; 2) diagnosed with a histologically ...

Characteristics of the study population

Table 1 shows the clinical and tumour characteristics of the study population....

Survival analysis in relation to tumour perfusion

The results of the survival or Kaplan-Meier curves are summarised in Table 2 and Fig. 2, which divides our population according to the optimal threshold for perfusion percentage (≤3.0 or >3.0). Overall mean survival was 20.6months (SD: 3.2; 95% CI: 14.3–26.7). We can observe that there is a statistically significant decline in mean survival for patients with a rCBV value greater than 3.0 compared to the group with a...

Discussion

In our study, we have found an association between MRI perfusion in the initial study and the length of survival of patients diagnosed with high-grade gliomas. Therefore, cerebral perfusion can be regarded as a prognostic marker in this disease. We observed that in the group of patients exhibiting intratumoural values of rCBV >3.0, the mean survival time decreased significantly compared to the group whose values were ≤3.0 (14.6months vs. 22.8months, respectively).

These results are in line...

Author contributions

1 Research coordinators: FFV, MBB, ERR, JSV, FBR and MRG....

2 Study concept: MRG....

3 Study design: MRG and ERR....

4 Data collection: JSV....

5 Data analysis and interpretation: MBB....

6 Data processing: MBB....

7 Literature search: FFV and ERR....

8 Drafting of article: FFV....

9 Critical review of the manuscript with intellectually relevant contributions: FBR....

10 Approval of the final version: FFV, MRG and JSV....

...

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Conflicts of interest

The authors declare that they have no conflicts of interest....

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