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When do a low-grade glioma appear?

Gliomas are the most common tumour of the brain. The problem of WHO grade II and higher gliomas is the infiltration: it is not possible to see the whole tumour on a MRI examination because a part of it is underside the detection threshold [1]. Inevitably an anaplastic transformation occurs, that rapidly causes the demise of the patient.

A recent clinical study showed that the growth of low-grade gliomas appears linear, at roughly 2 mm/yr [2]. Is it possible to assume that it is always true ? Using this property, can we extrapolate the date of birth of gliomas ? To answer this questions, we use a diffusion-proliferation model, employed with success for high-grade gliomas [3]. It is a simple model (few parameters) that can explain the constant velocity of the front visible with MRI at large times.

This model is based on a partial differential equation where the concentration of tumour cells is determined by the migration and by the proliferation of the cells. We assume that the tumour is symmetric and begins with a single cell.

The model predicts the existence of a "silent period": the tumour is growing, but remains under the detection threshold and thus it is not visible. A consequence of this phase is that the extrapolation always underestimates the age of the tumour predicted by the diffusion-proliferation model.

We analyse data on real-life patients with the model. We estimate the age of the tumour at the time of the first MRI examination, the age of the patient at the onset of the tumour and the coefficients of diffusion and proliferation.

We also apply the model to patients who do not present symptoms, and we find, as expected, that the tumour age at time of MRI is smaller than in the case of symptomatic patients.

References

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