

Imaging of tumour blood flow and necrosis using stable Xenon CT: can angiogenesis and necrosis be quantified in vivo?

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The challenge

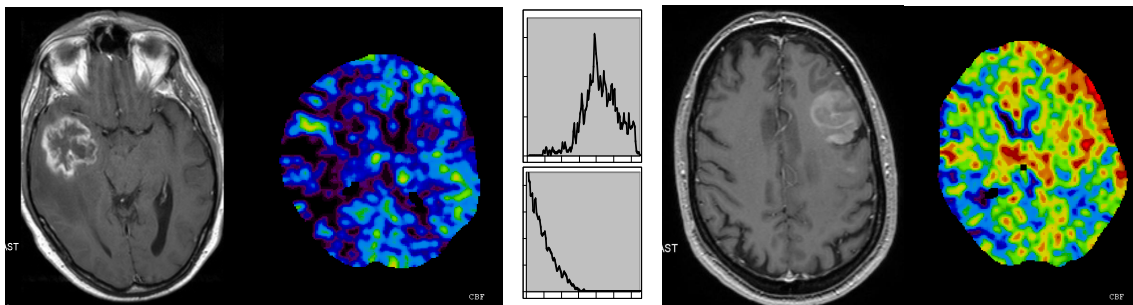
4,400 brain tumours are newly diagnosed per year, of which glioblastoma is the most common and most malignant. The median survival is around one year. Tumour angiogenesis plays a key role in the growth and spread of glioblastoma and is the target of new trials of vascular endothelial growth factor (VEGF) inhibitors. In vivo assessment of tumour biology in this area is of importance in identifying different patient subgroups and monitoring treatment. We have measured quantitative regional cerebral blood flow (CBF) in glioblastoma patients using Xenon CT.

Methods

In an ongoing pilot study patients presenting to St George's with suspected glioblastoma since August 2008 have had stable Xenon CT scan measurement of CBF in the tumour as well as the contralateral "healthy" brain. We have also analysed the pathological specimens to quantify tumour necrosis.

Results

In 19 patients studied so far there is wide variability of mean tumour bloodflow (mean 37.5 ± 19.3 ml/100g/min). The different distributions of the tumour flow values suggest that the necrotic element of the tumour may be predicted from the shape of the flow value histogram.



Right temporal tumour: reduced blood flow (lower histogram)

Left frontal tumour: increased blood flow (upper histogram)

Preliminary conclusions and ongoing challenges

Total tumour blood flow may be measured reliably and an estimate of necrosis generated from the distribution of flow values. The relationship to angiogenesis within these tumours however is far less clear as neovascularisation is associated with complex local haemodynamic changes including thrombosis of immature blood vessels. In vivo measurement of tumour biology will grow in importance to monitor response to novel treatment strategies and we consider further complementary techniques.