A Non-Invasive Approach for Molecular Characterization of Glioblastoma Multiforme: Magnetic Resonance Imaging Correlation with cDNA Microarray Expression Profiles

Christine Nardini, Bologna, Italy; Soonmee Cha,MD, San Francisco, CA; David Wang, San Diego, CA; Max Diehn,MD PhD, Stanford, CA; Mary Mayo, San Francisco, CA; Luca Benini,PhD, Bologna, Italy; Giovanni De Micheli,PhD, Stanford, CA; Michael Kuo,MD, San Diego, CA;

INTRODUCTION

cDNA microarrays, allowing for the massively parallel, high-throughput evaluation of gene expression, have led to important insights about cancer. However, they require invasive procedures to obtain the genetic material. This study aimed to determine whether modifications in gene expression levels in glioblastoma multiforme (GBM) could be non-invasively inferred from conventional magnetic resonance imaging (MRI).

METHOD

Analysis of cDNA microarrays, each containing ~23,000 elements representing over 17,000 unigene clusters, was performed comparing the tissues of 20 GBMs from 20 patients. For every patient, two radiologists, uninformed of the underlying genomic data, evaluated the corresponding pre-resection MRI scans (standard T1, T2 and contrast enhanced) and categorically scored each scan across four tumor imaging parameters: degree of mass effect, contrast enhancement, T2 heterogeneity and edema. Correlation between gene expression and imaging score profiles and their statistical significance were computed.

RESULTS

Two out of four imaging parameters showed significant correlation. The first parameter, contrast enhancement, positively correlated ($p<0.05$) with genes involved in angiogenesis regulation and with endothelial-specific genes. Interestingly, this parameter also correlated ($p<0.05$) with activation of B cell and T cell-specific genes, and immune cell signaling genes. The second parameter, mass effect, demonstrated significant correlation ($p<0.01$) with a gene cluster involved in cell cycle regulation and progression.

CONCLUSION

MR imaging of GBM, with genomic correlation, may yield more detailed information about GBM tumor biology than previously appreciated with MRI alone. In particular, certain MR imaging parameters may allow us to capture genomic insights into GBM in a non-invasive fashion. Further investigation into this area is warranted.