Neurobiomarkers of Cognitive Dysfunction in Patients with Cancer

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Impact of Cognitive Difficulties

Neuroimaging Biomarkers

- T1-weighted MRI
- Functional MRI (fMRI)
- Diffusion Tensor Imaging (DTI)
Hyperactivity


Hypoactivity


Scale-free, Small-world Brains

Disrupted Small-World Organization


Critical Brains

Integration vs. Specialization
Random vs. Ordered
Efficiency vs. Metabolic Cost
Stability vs. Flexibility
Scale-Free Dynamics

Fractal behavior in fMRI signals
- Long-range dependence ("long memory") and self-similarity in time
Long Memory

- Anti-correlated
- Random, white noise
- Long memory

Dong, J, et al. 2018. Front Neurosci, 12, pp. 34.
1/f Distribution

Treatment Naïve Breast Cancer

Topological/Dynamical Imbalance

Excitotoxic Neural Activity?

Breast and other tumors initiate neurogenesis and release nerve growth hormone.

Tumor aggressiveness associated with tumor-related neurogenesis.

Aberrant CNS activity via peripheral innervation?

Vascular Effects?

Malignant tumors and inflammatory responses associated with angiogenesis

VEGF elevated following chemotherapy (Ng et al. 2013)

Increased incidence of cerebral small vessel disease (Koppelmans et al. 2015)