

COMPUTED TOMOGRAPHY (CT) IMAGE

Figure 1



(From *Textbook of Neuropsychiatry and Clinical Neurosciences*, Yudofsky and Hales, 2002. Permission from Hales RE) Kile SJ. *Mental Fitness*. 2004;3(3):24-31.

schizophrenia.⁸ Furthermore, hypometabolism of the limbic structures including the anterior cingulate and hippocampal cortex were found in all patients with schizophrenia compared to controls in this study. PET can also be used as a neurochemical imaging technique allowing investigators to measure *in vivo* specific molecules and proteins (eg, receptors, transporters, and enzymes) important in the pathophysiology of schizophrenia.⁹

SPECT (single photon emission computed tomography), developed in the 1980s, also utilizes radiotracers for functional imaging as well as neurochemical imaging (Figure 4). The radioisotope involved only releases one photon per disintegration, and therefore SPECT has a somewhat inferior spatial resolution to PET.¹⁰ This type of radiotracer is easier to obtain making SPECT less expensive and more clinically available.

In 1990 a new technique for functional imaging emerged, fMRI (functional magnetic resonance imaging), and with it came several advantages. fMRI provides increased spacial and temporal resolution without the need for invasive radioactive tracers and detects differential properties of deoxygenated versus oxygenated hemoglobin. This blood oxygen level dependent (BOLD) is utilized to measure brain activity in response to tasks (Figure 5). The majority of fMRI studies of schizophrenia demonstrate abnormal prefrontal responses to cognitive tasks, most commonly

the dorsolateral prefrontal cortex.¹¹ This region of the brain is important for working memory. As noted above, hypofunction of the prefrontal cortex has been correlated with the negative symptoms of schizophrenia.

MRS (magnetic resonance spectroscopy), also developed in the 1990s, is able to detect concentrations of certain brain molecules based on the principle that their constituent atoms have characteristic responses to the magnetic field produced by the MRI scanner. MRS studies have shown that patients with schizophrenia demonstrate low concentrations of N-acetyl aspartate (NAA), a measure of neuronal integrity (Figure 6).¹²⁻¹⁴

DTI (diffusion tensor imaging) is one of the newest MRI techniques that permits the visualization of white matter tracts (Figure 7). DTI has been used to detect diffuse white matter abnormalities in hemispheres in patients with schizophrenia.¹⁵ Focal white matter abnormalities have also been found using DTI in the frontal lobes¹⁶ as well as in the corpus callosum.¹⁷

A SUMMARY OF NEUROANATOMIC IMAGING FINDINGS IN SCHIZOPHRENIA

Enlargement of the lateral ventricles is one of the most prominent findings in the imaging literature.^{18,19} Enlarged temporal horns of the lateral ventricles correlate with abnormally small neighboring volumes