Neuroimaging in Psychiatry
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Imaging Modalities

• Molecular Imaging (SPECT, PET)
• MRI (structural, fMRI, DTI, spectroscopy)
• Optical imaging
• EEG, MEG
• None are currently used to diagnose or help prognosis of *individual* patients with psychiatric illness.
• All are useful in research, with group level studies, and some have helped in treatment development
Summary points

• PET imaging has helped to establish the most effective medication dosing strategies
• Imaging could, it is hoped, lead to earlier diagnoses - eg in Dementia.
• Neuroimaging can help inform our models of healthy psychology and of psychiatric disorder, and may provide a rational basis for various interventions
In-vivo molecular imaging

The purpose of molecular imaging is to improve understanding of biology and medicine through non-invasive in vivo investigation of cellular molecular events involved in normal and pathologic processes.

Currently clinical molecular imaging is mainly PET and SPECT.

A critical and rate limiting factor is the development of imaging tracers [probes].
The Techniques: 1. PET
Non-selective molecular imaging
SPECT or PET can measure the global pattern of functional loss by mapping blood flow or glucose metabolic rate
By use of novel ligands that ‘bind’ to specific molecular targets, PET and SPECT can probe more selective abnormalities in patients with AD. [R.R]-123I-QNB is a selective ligand that binds with high affinity and selectivity to acetylcholine muscarinic receptors.
Dopamine D2 Receptors are Lower in Addiction

Cocaine  
Alcohol  
Heroin  
control  
addicted

Reward Circuits
Non-Drug Abuser

Reward Circuits
Drug Abuser

DA D2 Receptor Availability
Caused or Consequence of Drug use?

Rat not liable to addiction

Impulsive rat, liable to addiction

Dalley et al 2007
Science
For most first episode patients, 2mg haloperidol provided 65% D2 occupancy.
Effect of amphetamine (0.3 mg/kg) on $[^{123}\text{I}]$IBZM binding in healthy controls and untreated patients with schizophrenia. The $y$ axis shows the percentage decrease in $[^{123}\text{I}]$IBZM binding potential induced by amphetamine, which is a measure of the increased occupancy of D$_2$ receptors by DA following the challenge. Laruelle et al 1996 PNAS
MRI
The fore-runner of structural MRI...

CEREBRAL VENTRICULAR SIZE AND COGNITIVE IMPAIRMENT IN CHRONIC SCHIZOPHRENIA

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Summary
By comparison with age-matched controls in employment, 17 institutionalised schizophrenic patients were shown by computerised axial tomography of the brain to have increased cerebral ventricular size. Within the group of schizophrenic patients increased ventricular size was highly significantly related to indices of cognitive impairment.

THE LANCET, OCTOBER 30, 1976
But take care with confounders

See Ho et al 2011, Lewis et al 2011, Archives of General Psychiatry for discussions
Further (clinical) pros and cons of imaging

- Most treatments involve medicines, and most MRI doesn’t measure chemicals
- But …
How do antidepressants work?

- By dampening brain activity to negative self-descriptors?
  - Simplicio, Norbury & Harmer, Molecular Psychiatry 2012
Subthalamic Nucleus Stimulation in Severe Obsessive–Compulsive Disorder

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M.D., Ph.D., Jean-Luc Houeto, M.D., Ph.D., Pierre Pollak, M.D., Ph.D., Alim-Louis Benabid, M.D., Ph.D., Yves Agid, M.D.,
Ph.D., Paul Krack, M.D., Ph.D., Bruno Millet, M.D., Ph.D., Antoine Pelissolo, M.D., Ph.D., for the STOC Study Group
Amphetamine results similar to psychosis patient results
Summary points

• PET imaging has helped to establish the most effective medication dosing strategies

• Neuroimaging can help inform our models of healthy psychology and of psychiatric disorder, and may provide a rational basis for various interventions
Thanks!

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