Pulse Sequences to Clinical Applications in the Brain: Neuropsychiatric Disorders

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Target audience. Anyone interested in learning more about imaging in psychiatry

Highlights

- Imaging can reveal underlying neurobiological differences in mental illness
- Meta analysis of the extensive imaging literature often shows consistent abnormalities
- Machine learning approaches can classify different disorders and/or symptoms
- Pattern recognition of in vivo MR data can predict response to treatment
- The biggest remaining challenge is consistency in data quality across imaging centres

Background

Whilst the use of MRI techniques has become a cornerstone of the neurology clinic, the application of such methods in mainstream psychiatry has, until recently, been rather limited. The most common need was a conventional structural MR exam to rule out an underlying, organic pathology as a cause of the ensuing psychiatric symptoms. For example, patients with chronic schizophrenia have an increased prevalence of incidental brain abnormalities [1] and typically ~5% of patients with psychosis receive a more informed clinical management as a consequence of an MRI. Nevertheless, recent meta-analyses of MRI in numerous psychiatric disorders have revealed that there are consistent structural abnormalities in major depression [2], post traumatic stress disorder [3] and schizophrenia [4] but without doubt the biggest positive impact has come from the MR investigation of Alzheimer's Disease. Objective longitudinal assessment of those subjects at risk of developing dementia led to the visualization of neurobiological changes in tissue content over time which preceded the clinical signs [5]. This not only aids diagnosis but also opens up the potential for earlier, prophylactic intervention.

Current Practice

The more recent advent of dynamic MR imaging methods such as BOLD based FMRI have, over the past decade, complemented earlier radionuclide imaging techniques and blossomed into a widely used psychiatric research tool. The improved spatial acuity to interrogate complex networks of structures including deep seated regions of the temporal lobe, thalamus and cingulate often implicated in mental illness had previously been impervious to more superficial (cortical) methods such as EEG. Since the mid 1990's one might argue that psychiatry is one of the clinical disciplines which has most willingly embraced the field of functional MRI. The transition from the chaise longue to the scanner couch has gained even greater momentum with the advent of motion tolerant imaging sequences, more standardized, quantitative neuroimaging data collection [6] and multivariate analytical approaches which are now being applied to the discrimination and classification of numerous psychiatric conditions such as autism [7], schizophrenia [8] and Alzheimer's disease [9]. Many of these studies are, however, restricted to specialist centres with the critical mass of expertise and patient data to allow the first generation of MRI based "classifiers" to be created. Scaling up our effort and moving from such boutiques to the collection, analysis and classification of data from a broader range of imaging centres and system manufacturers is now warranted. The ADNI initiative (www.adni-info.org) is a stellar example of this concept in practice for dementia research.

Future Challenges

Psychiatry is, however, plagued by the breadth and combination of symptoms which can be amalgamated to give a diagnosis. For example, there are 5 broad symptom characteristics in the current DSM-IV criteria for schizophrenia of which only 2 need to be present for an unequivocal diagnosis. Therefore a shift to a more symptom based correlation with neuroimaging data may well be warranted. Nevertheless the role of MR as a prognostic tool to help predict subsequent decline or response to tightly prescribed pharmacological [10] or talking therapies [11] is gathering pace. To summarize, whilst unequivocal delineation of a psychiatric condition by MRI might remain a challenge, integration with other clinical and biological information will lead to a more holistic assessment and improved patient management as we attempt a more stratified approach to treatment.

References

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