

## WHAT IS BIPOLAR DISORDER?

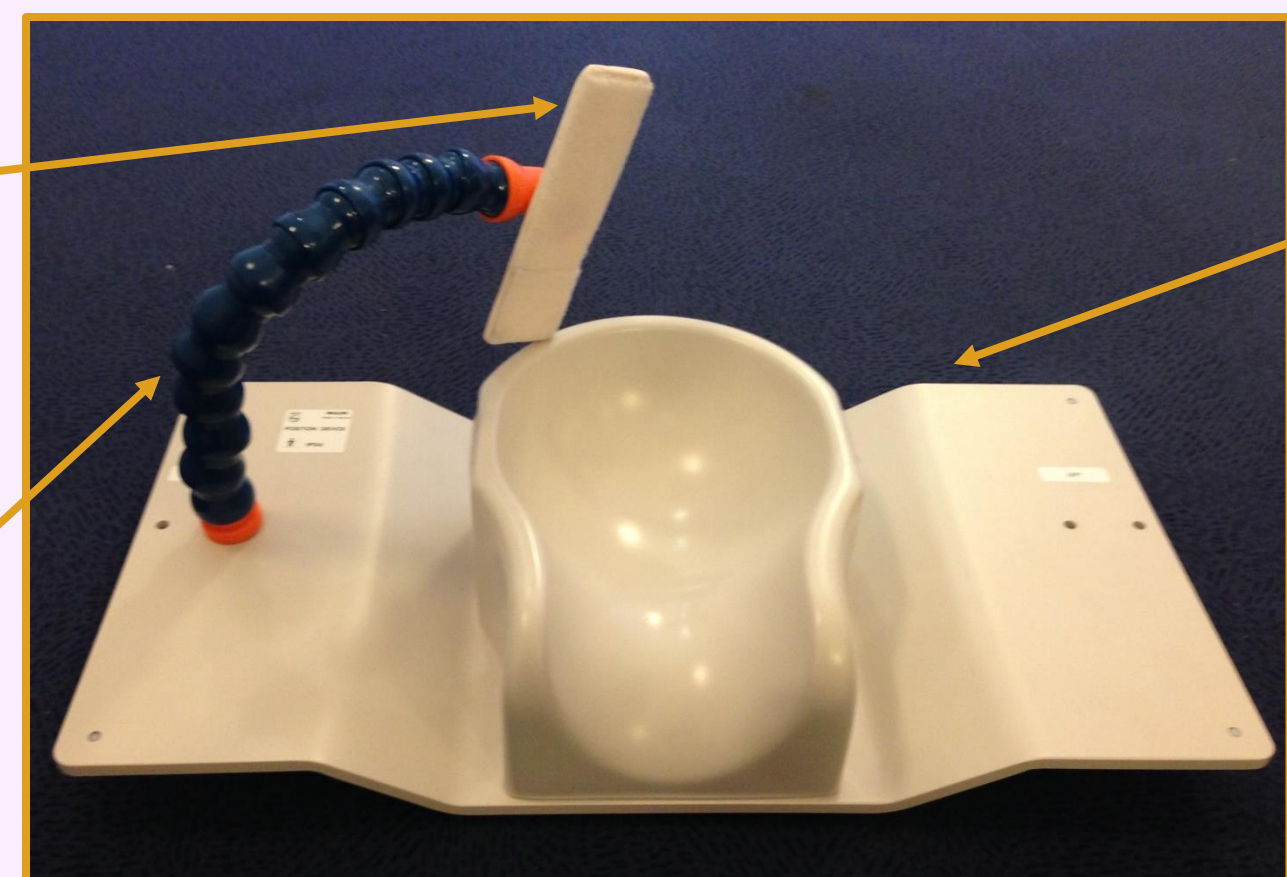
Bipolar disorder is a common psychiatric illness characterized by periods of depression (low mood, loss of enjoyment, reduced energy) and mania (elevated mood, racing thoughts, disturbed behaviour). It is highly disabling and can reduce lifespan on average by 9 years, with one third of patients attempting suicide. The cause of bipolar disorder is poorly defined, but it is known to be associated with tangible changes in brain structure, composition and function. Lithium is used in the management of bipolar disorder, treating and preventing episodes of mania and depression as well as reducing suicidality. Not everyone responds to lithium, and the ability to predict response would be of great benefit. Clinical features are of limited value in predicting response to lithium but magnetic resonance techniques hold great potential.

## MAGNETIC RESONANCE FINDINGS IN BIPOLAR DISORDER

The presence of **White Matter Hyperintensities (WMHI)** – figure 1 – is one of the most consistently replicated findings in MRI studies of bipolar disorder. WMHI are thought to reflect abnormal localised water content in cerebral tissue and whilst a feature of normal ageing, in bipolar disorder they can be found in patients of all ages, and so some authors argue that this may be a trait marker of bipolar disorder. Importantly, white matter lesions are predictive of response to lithium (1). A better understanding of the basis of the WMHI might provide insight into understanding of lithium treatment.

## THE SOLUTION

We designed a coil holder using a novel combination of proprietary and in-house made components. Loc-Line™ - a modular hose system - offered the potential for flexible positioning but did not interface with the coil in its standard form. We constructed secure coil attachment systems using a 2 part casting resin in order to create a safe, reliable structure. The final holder can be seen below:



Hand-made piece of plastic with Velcro™ to attach the coil

Pre-manufactured Phillips head rest

Loc-Line™ modular system

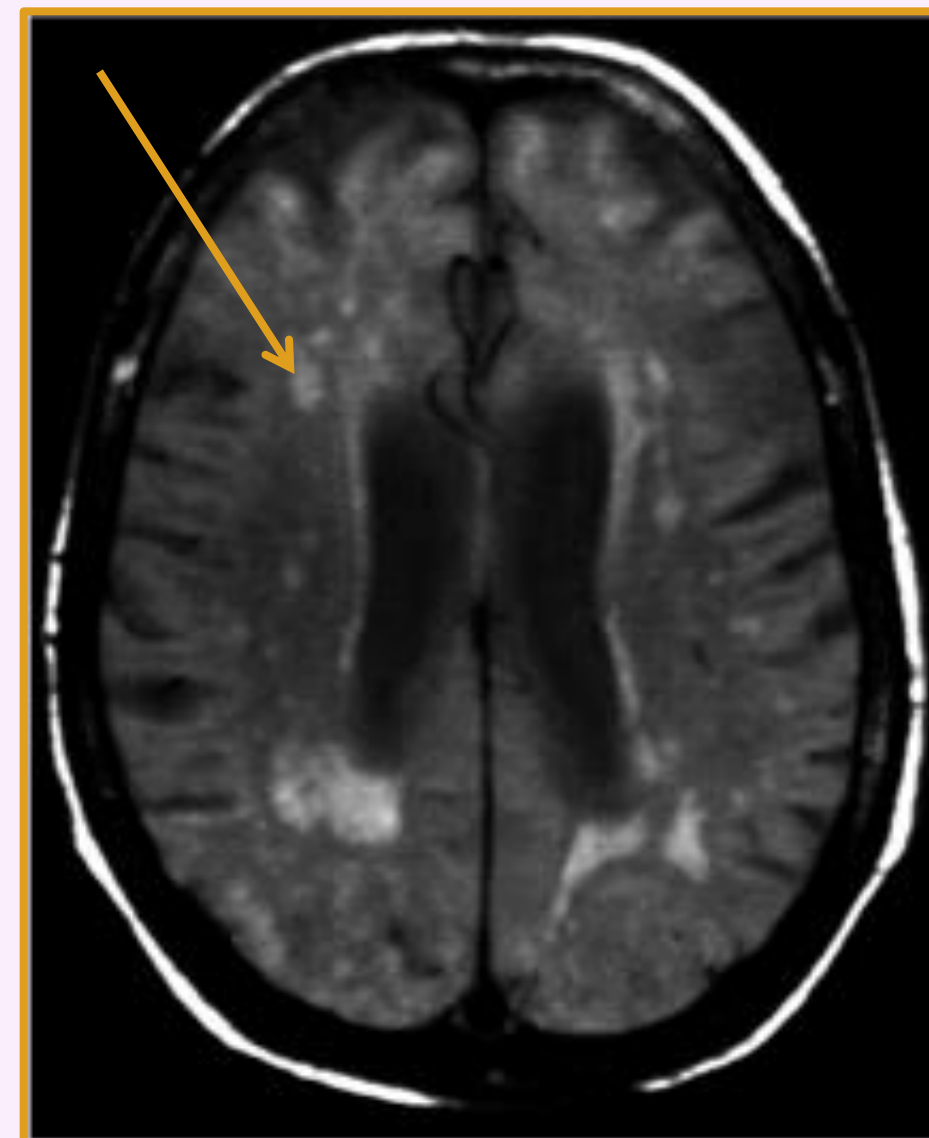


Figure 1: An MRI image of a bipolar patient. WMHI's can be seen in the deep frontal white matter.

## 32P MAGNETIC IMAGING IN BIPOLAR DISORDER

Magnetic resonance (MR) techniques can be used to measure more than just structure. Suitably adapted, an MR system can directly detect phosphorous in tissues (32P MR), providing valuable information about tissue function and damage in illness states. In bipolar disorder, two observations have been found using 32P MR:

- WMHI have been associated with a low pH in brain tissues (2)
- Low pH has been associated with response to lithium treatment (3)

Whilst taking into account the previous observation, it is apparent that a link between all three observations could be inferred. However, each observation was a result of three separate studies. Therefore, in order to gain a better understanding of lithium treatment, and possibly trait markers or the psychopathology of bipolar disorder, these observations must be unified in a single study.

Therefore, the Bipolar Lithium Imaging Spectroscopy Study (BLISS) has been designed by David Cousins and his colleagues to incorporate the unification of all three observations.

## AIM

The aim of the project was support the technical development of MR techniques in order to enable safe measurement of pH in the brain using 32P MR techniques.

## THE CHALLENGE

The Newcastle University Magnetic Resonance Center has the capacity to measure 32P but the equipment only for measuring in muscle. A literature review of head 32P studies confirmed that the measurement of the frontal lobe will be most valuable. And so, the only obstacle left before phosphorous can be measured is the lack of a positionable device to hold the 32P coil. In order for it to be safe to use in an MRI scanner, the holder must consist of **no metal**. Moreover, it must hold a **reliable and robust** position, in order for there to be no movement. It also must be **patient friendly**, to reduce stress in the MRI scanner.

## CONCLUSION

The coil holder that we constructed over the eight week placement is currently in use for the BLISS study, in order to gain the valuable information on pH and WMHI in brain tissue. Additionally, the coil holder will be available at Newcastle University for future measurements of 32P in the brain.

## REFERENCES

1. Kato, T., Fujii, K., Kamiya, A., & Kato, N. (2000). White matter hyperintensity detected by magnetic resonance imaging and lithium response in bipolar disorder: a preliminary observation. *Psychiatry and clinical neurosciences*, 54(1), 117-120.
2. Kato, T., Murashita, J., Kamiya, A., Shioiri, T., Kato, N., & Inubushi, T. (1998). Decreased brain intracellular pH measured by 31P-MRS in bipolar disorder: a confirmation in drug-free patients and correlation with white matter hyperintensity. *European archives of psychiatry and clinical neuroscience*, 248(6), 301-306.
3. Kato, T., Inubushi, T., & Kato, N. (2000). Prediction of lithium response by 31 P-MRS in bipolar disorder. *The International Journal of Neuropsychopharmacology*, 3(01), 83-85.