

# Example of approaches to brain stress testing: bold magnetic resonance with compu...

[Technology](#), [Development](#)



## **Introduction**

Human brain is a complex organ and so are its diseases. Over the years numerous techniques, devices and processes have been developed that can help us to correctly access and diagnose the problem areas and provide solutions to them (14). Computer controlled delivery of carbon dioxide is a method that is conducted with the help of a gas blender that works to supply and alter carbon dioxide to the brain creating tensions in the brain (10) (16).

## **Carbon dioxide challenge**

Changes in the carbon dioxide tensions in the brain are capable of sufficiently affecting the Brain and its functioning (1) . Due to increased carbon dioxide level in the Cerebral blood flow (CBF) can shoot up to a considerable degree of 5-11 percent/mmHg along with the rise in cerebral blood volume (7) (11). When the CO<sub>2</sub> challenge is taken along with magnetic resonance imaging (MRI), the improvements in the reproducibility and precision the true and exact regional assessment can be optimally depicted (7). To determine the changes in the cerebral blood flow (CBR) and tissue oxygenation, it has been observed that the higher field strength magnetic resonance imaging using blood oxygen level dependent (BOLD) contrast provides better and improved resolution (8) (5). Most researchers use BOLD (Blood oxygen level dependent) method for finding and locating the most active parts of the brain (9). Functional Magnetic Resonance Imaging, fMRI Functional Magnetic Resonance Imaging, fMRI is the method to investigate the brain areas and understand the active human brain. Functional Magnetic Resonance Imaging, fMRI studies always analyse the effects due to the

diseases at the group level and not the individual level (17) (4). fMRI is a kind of brain stress test that is used to determine the brain response to the given challenges (3). The aim is to look at the pattern of activation and not at the absolute value of the BOLD change (18) (12).

## **Diagnosis and treatment**

The two studies, namely the resting state and default mode are used to define the consciousness of the brain and the BOLD imaging that is directly related to the tasks. It is then used to demonstrate brain's regional interconnectivity (8). Transcranial Doppler is a technique which is used to periodically access the blood velocity alterations that occur after the CO<sub>2</sub> challenge (7). ). The brain signals are always based on quantitative measures, so determining the neural activities within the brain is done by BOLD (12).

Higher levels of carbon dioxide raise the intracranial volume and pressure thus demanding greater neurocritical and neuroanesthesia care to control the amount of arterial CO<sub>2</sub> (13). Such alterations in the amount of CO<sub>2</sub> or CO<sub>2</sub> challenge and cerebral blood flow take place due to the incidents of brain injury or diseases (19) (20).

## **Proposed project**

In the proposed project functional magnetic resonance imaging has been introduced. However, due to the intrinsic complexity of the signal based on the opposing ways of alterations in blood vascular flow and oxygen metabolism and the interference of certain technical glitches of the image acquisition method the BOLD-fMRI method alone stands as an unreliable test.

In order to correctly benefit from this technique it is essential to gather the BOLD data as well as CMRO<sub>2</sub> i. e. the oxygen metabolism changes. In other words to deal with the issue, it is necessary to additionally take into consideration the oxygen metabolism (CMRO<sub>2</sub>) measurements. In several studies, it has been found that the coupling ratio of cerebral blood flow (CBF) to the oxygen metabolism (CMRO<sub>2</sub>) changes had a greater degree of reproducibility as compared to the individual responses.

### **Benefits of proposed study**

As it has been pointed out earlier with the advanced system of taking into consideration the BOLD data and CMRO<sub>2</sub> degree of reproducibility can be achieved. It advances the study of the working human brain and provides more in depth insights into the underlying issues and requirements that can then be addressed accordingly (12).

### **Research plan**

The stepwise change and the ramp change are the two patterns of bringing alterations in CO<sub>2</sub>. Stepwise change is used to study the dynamics of the vascular response. While ramp change helps to understand the steady-state response to carbon dioxide (2). Stepwise change is brought about by the square wave stimulus and ramp stimulus generates ramp changes. Dynamic brain imaging in an atmosphere of carefully controlled changes in carbon dioxide is used to understand cerebrovascular reactivity (CVR).

## **The two methods used for analysis of the stimulus obtained from the studies are as follows.**

- The ratio between the mean BOLD signals to the alterations in carbon dioxide to gauge regional cerebrovascular reactivity (CVR) gives the output as a voxel-based ratio of change, MR-BOLD (2).
- Detrended fluctuation analysis (DFA) can be used to determine the voxel-based fractal time analysis of the MRI BOLD signal. This method can be used to identify the activated cortical areas (2) (6) (15).

## **Summary**

The changes caused to the activeness of the brain areas are detected and mapped. This process is called Magnetic Resonance Imaging (MRI). MRI images the areas of brain based on the blood oxygen level dependent (BOLD) approach. This technique is used to conduct the brain stress testing to detect the active brain areas. In brain stress testing, the patient is given this challenge and the physiological responses in the brain are measured quantitatively to ascertain the working of the brain. The challenge given to the patient can be of the form of some chosen task or stimulus or a change of state due to a drug or other physiological manipulation.

Since the above mentioned techniques provide a specialized method to deal with the complexities of the human brain, the dual stimulus of square wave and ramp and the dual analysis carried out can to a great extent provide true assessment of the working brain.

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