

“Techniques in Cerebrovascular Reserve (CVR)”

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Over the last two decades or so there has been increased recognition of the interdependence of neuronal and vascular elements of the brain in terms of functional units as opposed to independent constituents. These “neurovascular units (NVU)” represent subsystems in the brain that are coupled to each other such that activity in one reflects activity in the other. Activation of neurons leads to increases in blood flow in the spatially co-localized microcirculation. The ability to monitor brain blood flow fluctuations therefore enables mapping of functional neural networks.

In this biological construct, pathological conditions that only affect the vascular component of the unit would also be expected to physiologically affect the neuronal component. Primary vascular diseases can affect the vascular component of the NVU either directly or indirectly depending on where the disease is located in the vasculature. If the disease is located in the proximal arteries resulting in large vessel stenosis or occlusion, then the ability of the vasculature to increase flow in response to neural activity will be limited as some or all of the vasodilatory capacity (vascular reserve) will be consumed just to maintain resting blood flow at normal levels. The short-term consequence of this condition is a considerable increase in the risk (up to 10 times greater risk) of disabling ischemic stroke if vascular reserve is exhausted compared to the same stenoses where vascular reserve is maintained.¹ The longer term consequence of this condition in patients who do not have an acute stroke is thinning of the cortical mantle^{2,3} Diabetes is an example of a disease that directly impairs vascular function through its adverse effects on endothelial function. Vascular reserve and reactivity are reduced in diabetes even in the absence of large vessel disease.⁴ Vascular diseases that directly or indirectly affect the integrity of the NVU have been associated with cognitive decline.⁵ The ability to assess CVR in patients is therefore clinically relevant.

The purpose of this presentation is to discuss the methods that are available for measuring CVR with emphasis on MRI based methods. Issues concerning the type of vasodilatory stimulus will be discussed as well as the MRI methodology used to acquire the data.

References:

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