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Use of TRUE FISP Cardiac Gated Studies for Visualization of 4D Dynamic Pulsatile Flow in Cerebral Vasculature

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Technology description

Introduction

The maintenance of cerebral blood flow and pressure is critical for normal brain function, and their alteration is associated with a number of disease states. However, these properties are not static, rather they fluctuate and pulsate with the systolic increase in blood pressure during the cardiac cycle. Considerable data have demonstrated that the measurement of pulsatile pressure in the brain is a useful marker for many diseases, particularly hydrocephalus, traumatic brain injury, and other conditions associated with changes in the biomechanical properties of the brain and intracranial pressure (ICP).

In addition to being a biomarker, pulsatile pressure can stress highly-perfused organs, including the brain, and cause vascular damage that may advance pathological conditions, such as aneurysmal disease. Pulsatile stress increases with age since vessels stiffen due to a decrease in elastin, which dampens the pulsations in the brain. This increased stressed is believed to be involved in the pathophysiology of lacunar infarcts, mild cognitive impairment, dementia, and other conditions.

Three primary techniques have been used to quantify intracranial pulsatility: continuous ICP monitoring, transcranial Doppler ultrasound (TCD), and magnetic resonance imaging (MRI). ICP monitoring is an invasive method that measures pressure pulsatility through a pressure sensor placed within the brain. In comparison, TCD and MRI measure flow pulsatility in external, non-invasive manners: TCD measures the velocity of blood flow in large arteries using a transducer, while MRI measures the net flow waveform over the cardiac cycle in intracranial arteries or veins, or in cerebral spinal fluid pathways, by imaging. Each of the three techniques has unique benefits not available when using alternative methods to measure intracranial pulsatility. Therefore, a non-invasive method that gives continuous measurements of cerebral blood velocity and flow over time, would greatly enhance the capability of physicians to diagnose and monitor a number of diseases influenced by cerebral blood flow and pressure.

Technology Description

Dr. Moise Danielpour and his colleagues from the Cedars-Sinai Medical Center have developed a method to visualize blood flow pulsatility in a four-dimensional fashion, allowing three-dimensional flow to be visualized over time during the entire cardiac cycle by MRI.

Application area

• Monitoring blood flow pulsatility in a 4-dimensional fashion in order to assess the severity, probability of progression, and success of intervention of many disease states, including but not limited to dementia, stroke, hydrocephalus, arteriovenous malformations, aneurysms, renal artery stenosis, development of atherosclerotic disease, and peripheral vascular disease

Advantages

Allows for three-dimensional visualization of turbulence and pulsatile flow over time in order to observe changes in disease states and enable comparisons with normal turbulence and pulsatile flow. Provides absolute velocity information available with TCD, as well as three-dimensional flow measurements possible with MRI

Institution

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