

Optimizing contrast administration for MRA

Although contrast enhanced (CE) techniques are well accepted as the standard of reference for most magnetic resonance angiography (MRA) applications, very little is known about the influence of injection rate and injected volume on contrast agent (CA) bolus shape. Unlike iodinated CAs in computed tomography angiography (CTA) or conventional digital subtraction angiography (DSA), gadolinium (Gd) based MR CAs have a non-linear relationship between CA-concentration and MR signal. Indeed, there have been no systematic investigations on the effect of injection rate and volume of gadolinium CAs, and published approaches are highly variable between institutions and are based on anecdotal evidence only.

To get the best possible SNR and CNR in a MRA exam a certain injection rate is needed to get a nice and tight bolus with high concentration of contrast agent in order to get good signal. However, if the Gd-concentration gets too high it comes to susceptibility effects and there is not only no further increase in signal but a decrease again. Concerning the injected volume it is important to sample the center parts of k-space during the peak concentration of contrast agent in the area of interest. However, the contrast bolus mustn't be limited to the sampling of k-space center because sampling of the k-space periphery without contrast agent being present theoretically leads to blurry vessel edges in a MRA exam. On the other hand contrast agent injection does not need to be as long as the acquisition because of contrast agent circulation time from the injection site to the area of interest.

This presentation will discuss the pros and cons of the most common contrast agent applications schemes including high and low injection rates as well as mono- or multiphasic injection schemes. Additionally, the relationship between sequence design / k-space readout scheme and the contrast agent application protocol will be explained.