

**WHAT IS PERFUSION  
WEIGHTED MR IMAGING ?**

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- **Perfusion weighted imaging** is a variety of MRI techniques that give insights into the perfusion of tissues by blood.

**TYPES OF PERFUSION  
WEIGHTED MR IMAGING**

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## Three types/techniques

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- Dynamic susceptibility contrast (DSC) MR perfusion
- Dynamic contrast enhanced (DCE) MR perfusion
- Arterial spin labelling (ASL) MR perfusion

**Dynamic Susceptibility Contrast  
MR perfusion (DSC)**

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## Dynamic Susceptibility Contrast MR perfusion (DSC)

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- DSC perfusion exploits the regional susceptibility induced signal loss caused by paramagnetic contrast agents (such as commonly used gadolinium-based compounds) on T2 weighted images.
- Although this technique can be performed with both T2 (e.g. spin echo) and T2\* (e.g. gradient-echo echo-planar) sequences, T2\* techniques are more commonly employed [the former requires higher doses of contrast].

# CLINICAL APPLICATION

## MR Perfusion imaging of the Brain

(Ischemic stroke and Brain tumors)

- Sequences
- Technique
- Curves and parameters
- Color maps
- Pitfalls

# 1- SEQUENCES

- *Dynamic 2D T2 or T2\* - gradient echo before and after IV gadolinium injection*
  - Signal intensity curve (single curve).
  - Concentration time curve (two curves, deconvoluted into one curve)
  - Color maps (for hemodynamic parameters).
- *Diffusion-weighted imaging (DWI)*

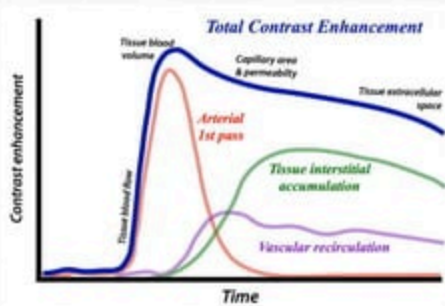


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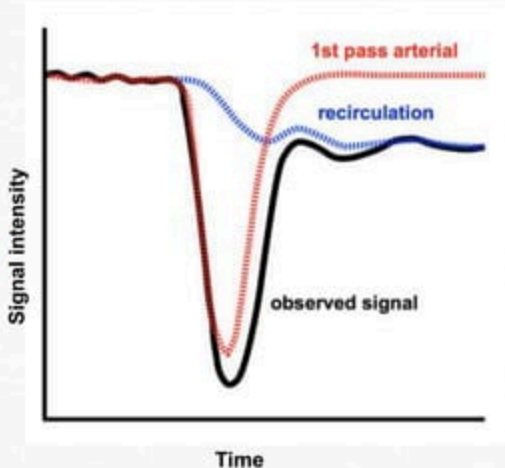
## 2- TECHNIQUE

- A bolus of gadolinium containing contrast is injected intravenously and rapid repeated imaging of the tissue is performed during the **first pass**.
- This leads to a series of images with the signal in each voxel representing intrinsic tissue T2/T2\* signal attenuated by susceptibility induced **signal loss proportional to the amount of contrast** primarily in the microvasculature



# TECHNIQUE

- Then a region's signal is interrogated over the time-course of the perfusion sequence, a signal intensity-time curve can be generated, from which various parameters can be calculated (rCBV, rCBF, MTT etc..)



# Cerebral blood volume (CBV)

## Relative CBV (rCBV)

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- CBV is defined as the volume of blood (milliliters of blood ) in a given amount of brain tissue (100 g of brain tissue).
- CBV can be calculated by assessing the **area under the concentration-time curve**, which in turn can be generated from signal intensity-time curves using dynamic susceptibility contrast (DSC) MR perfusion.

# Dynamic Contrast Enhanced MR perfusion (DCE)

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- DCE relies upon the T1-shortening effects of gadolinium-based contrast agents.
- An intravenous contrast bolus is injected and rapid repeated T1 imaging is obtained.
- Regional increased signal (T1 shortening) is due to gadolinium concentration which in turn will depend on a number of factors: intravascular gadolinium (i.e. true perfusion), and accumulation of gadolinium in the extravascular space (i.e. permeability).

# CLINICAL APPLICATION

## MR Perfusion imaging of the Breast (Breast tumors)

- Sequences
- Technique
- Curves and parameters
- Color maps
- Pitfalls

# 1- SEQUENCES

- *Dynamic 2D or 3D T1-weighted gradient echo before and after IV gadolinium injection*
  - Image post-processing.
  - Digital subtraction
  - Maximum intensity projection (MIP).
- *T2W-TSE or STIR sequences*
- *Diffusion-weighted imaging (DWI)*

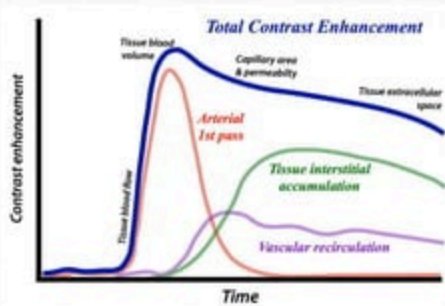
# SEQUENCES

- *Dynamic 2D or 3D T1-weighted gradient echo before and after IV gadolinium injection*
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  - Maximum intensity projection (MIP).
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- *Diffusion-weighted imaging (DWI)*



## 2- TECHNIQUE

- A bolus of gadolinium containing contrast is injected intravenously [0.1 mmol/kg, flow rate 2-3ml/min, followed by a saline flush (10-30 ml)] using an automatic injector.
- Images are processed by drawing Multiple ROIs within the breast tissues (abnormal, normal tissue) to derive enhancement curves.



### 3- CURVES & PARAMETERS

#### Breast MRI enhancement curves (Kuhl enhancement curves)

- Following administration of Gadolinium there can be three possible **enhancement kinetic curves** for a lesion on breast MRI.

## Dynamic Susceptibility

### Contrast MR perfusion (DSC)

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- Most frequently used techniques for **MRI perfusion**.
- Relies on the susceptibility induced signal loss on T2\* weighted sequences which results from a bolus of gadolinium-based contrast passing through a capillary bed.
- The most commonly calculated parameters are **rCBV**, **rCBF** and **MTT**.

## Dynamic Contrast Enhanced

### MR perfusion (DCE)

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- Sometimes also referred to as permeability MRI.
- Calculates perfusion parameters by evaluating T1 shortening induced by a gadolinium-based contrast bolus passing through tissue.
- The most commonly calculated parameter is **k-trans**.