Tissue perfusion, the rate of exchange of blood in a volume of tissue is quantified by physiologists in milliliters of blood per minute per 100 g of tissue. It is a measure of the delivery of oxygen and nutrients to the tissue and the simultaneous removal of waste materials, and intimately related to tissue viability.

In general, imaging techniques quantify perfusion by monitoring the passage or exchange of some "tracer". Using the principle of conservation of mass, an assumed or measured "tracer" input function, and external measurements (imaging) of the exchange or passage of the tracer, perfusion can be quantified. There are two kinds of tracers, "diffusible" tracers, and intravascular (blood-pool) tracers; both types must be detectable outside the body so they can be imaged. This means that in nuclear medicine techniques, such as single photon emission computed tomography (SPECT) and positron emission tomography (PET), the tracers must be tagged with radioactive isotopes. In contrast-enhanced CT, a nondiffusible contrast agent is used as the tracer, but CT, itself, involves substantial radiation exposure.

With MRI, there are two ways to measure tissue, and neither involves the use of ionizing radiation. The first is by quantifying the exchange of an exogenous blood-pool tracer like Gd-DTPA which has been introduced by injection and the second is by quantifying the local exchange between blood protons which have been "labeled" by RF and gradient manipulation and "unlabeled" blood.

This presentation will describe and compare these methodologies for quantifying tissue perfusion.

Educational Objectives:

1.To understand the distinction between MR measurements of perfusion, diffusion and blood volume.

2.To understand the various methods used for obtaining perfusion maps of the human brain.

3.To understand the differences and similarities of measurements of perfusion with MR, SPECT, PET, and CT.

4.Identify equipment requirements for the performance of MRI perfusion measurements.