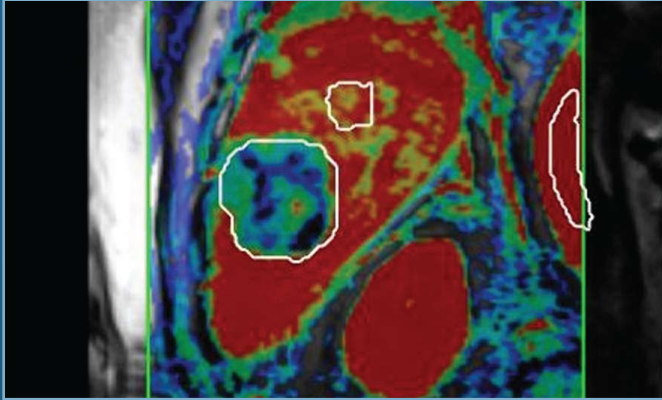


Dynamic Contrast-Enhanced MRI in Solid Tumors

*Dynamic Contrast-Enhanced Magnetic Resonance Imaging (DCE-MRI) has become a crucial imaging modality to noninvasively explore parameters such as **perfusion** and **permeability** in solid tumors. Such MRI parameters may be used as **quantitative endpoints** in **phase I Oncology trials** to evaluate the efficacy of novel **anti-angiogenic compounds**.*



Perfusion - MRI1 - IAUGC



Eurospin Test Object n°5 consists of test tubes made of agarose doped with Gadolinium corresponding to different concentrations and therefore T1 values (Middle), placed in a magnet (Bottom)

MRI CONTEXT

The most powerful characteristic of DCE-MRI is its ability to provide truly **quantitative MRI endpoints**. Instead of relative measurements with arbitrary units, DCE-MRI offers the possibility to **standardize** the quantitative values based on an **Arterial Input Function (AIF)**. The resulting quantitative endpoints are therefore more reliable and with higher physiological significance than semi-quantitative/relative endpoints.

The most challenging aspect in DCE-MRI trials is the ability of the sites to provide images of high quality. The acquisition procedure must be highly reproducible over time (tumor coverage, patient and slice positioning, contrast agent injection, AIF, etc.). Since DCE-MRI is usually not standard in the routine clinical setting, it is of tremendous importance to qualify the sites by providing training to the study MRI team and to use phantom scans to evaluate the quality of images.

SITE QUALIFICATION AND QUALITY ASSURANCE

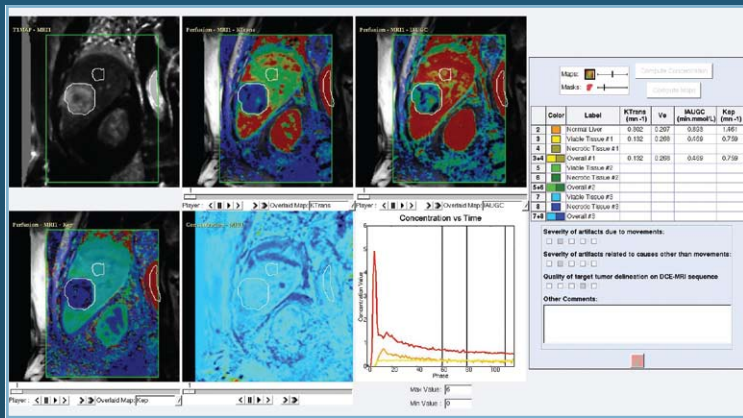
BioClinica uses the Uniformity & Linearity (UAL) and the Eurospin Test Object n°5 Phantoms for both initial site qualification and ongoing site QA. Phantom scans will allow assessing the quality of image acquisition and adherence to the study imaging protocol (geometric accuracy, spatial resolution, signal intensity uniformity, accuracy of T1 measurement). Phantom scans are usually repeated quarterly during the course of a trial.

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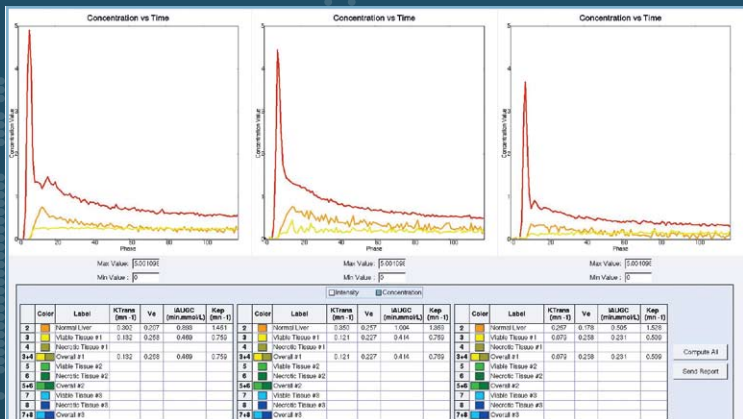
Dynamic Contrast-Enhanced MRI in Solid Tumors

Symbol	Definition
EES	Extravascular Extracellular Space
K_{trans}	Volume transfer constant between blood plasma and EES; Reflects contrast delivery (perfusion) and transport across the vascular endothelium (permeability)
K_{ep}	Volume of EES per unit of volume
V_e	Rate constant between EES and blood plasma
IAUGC	Initial Area Under the Gadolinium Curve

The contrast agent leaks from artery to extravascular extracellular space (EES)



T1, K_{trans} , IAUGC, K_{ep} and Concentration maps, along with Concentration-vs-Time Curves (Left-Right, Top-Down), Final quantitative results and example of an eCRF (Right)



AIF, tumor and healthy tissues Concentration-vs-Time Curves for 3 DCE-MRI examinations: Baseline and 2 follow-ups (Left-Right), Final quantitative results per scan (Bottom)

QUANTIFICATION OF DCE-MRI PARAMETERS

After data collection & QC, the DCE-MRI data is processed for the extraction of quantitative parameters. The following operations are performed:

- Automatic detection of the Arterial Input Function (AIF)
- Generation of T1 maps based on the acquisition of multiple fast Gradient Echo T1-weighted sequences with variable flip angles
- Conversion of MRI signal intensities to contrast agent concentration maps
- Generation of DCE-MRI maps
- Definition of Regions of Interest (ROI) corresponding to solid tumors (performed by central reader)
- Final extraction of quantitative parameters

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