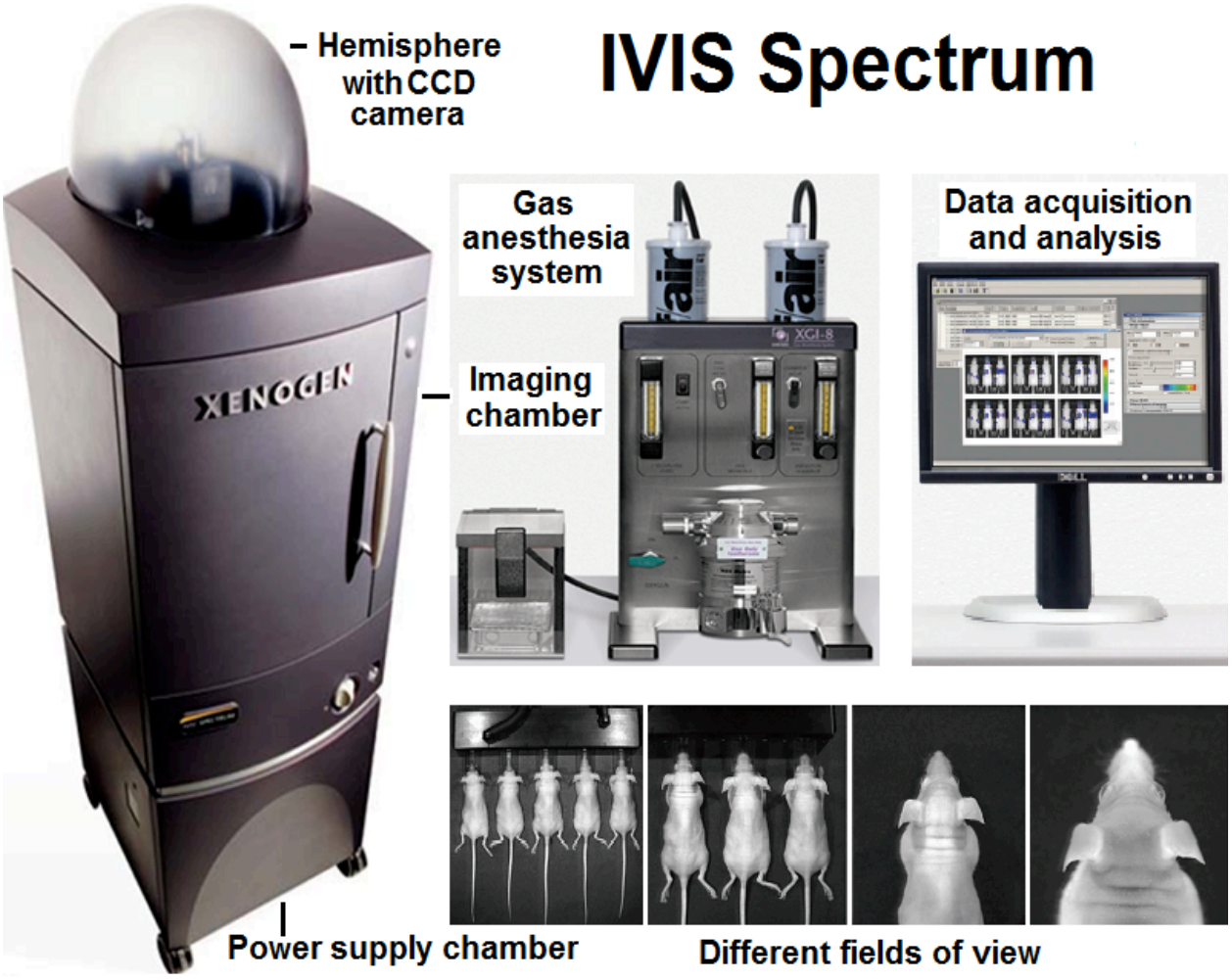
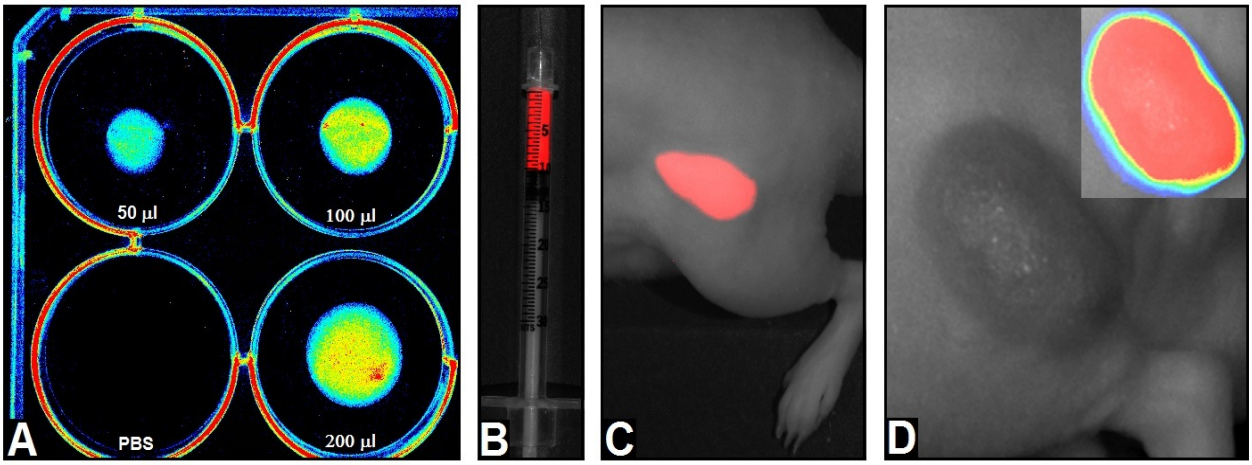
Preclinical optical imaging



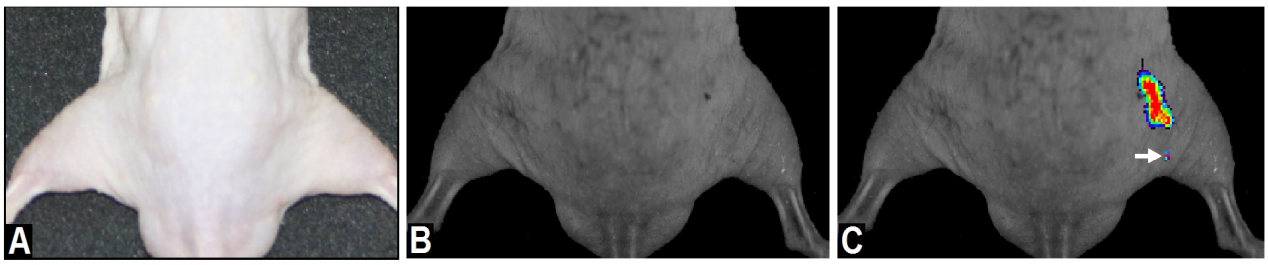
Preclinical optical in vivo imaging allows following up dynamic processes systems-wide in intact and compromised organisms. By the use of various genetically modified cells or animals or by the use of specific fluorescent markers or substrates a plethora of biological processes can be visualized non-invasively (a few selected examples of our own data are shown below). Noninvasive optical imaging thus not only complements existing non-invasive and invasive imaging modalities, it also represents a humane alternative of endpoint observations of autopsy material.

In vitro and in vivo tumor cells tracing



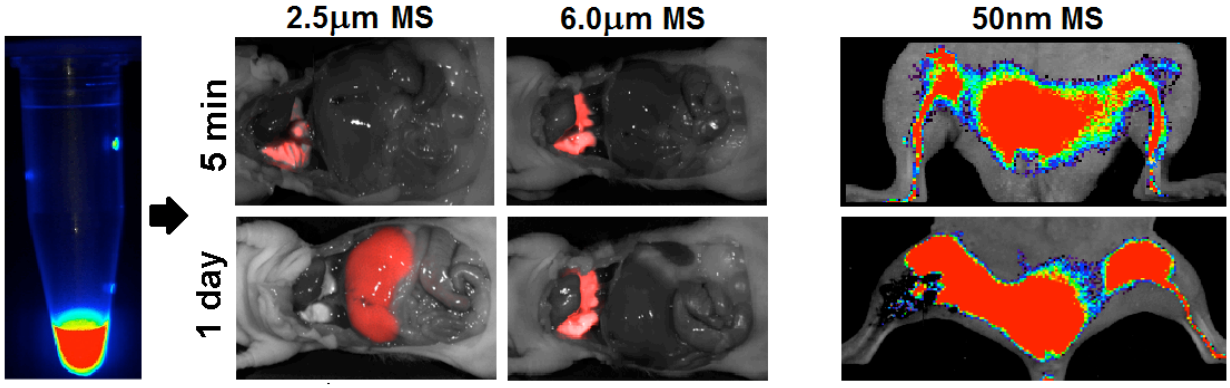
Imaging of tumor cells expressing infrared fluorescent protein (iRFP) in vitro (A). Follow up of iRFP expression before (B) and after s.c. transplantation (C and D). Of note, even subclinical tumor formation (e.g. without palpable tumor mass) can be identified (C) ultimately giving rise to a clinically overt tumor mass (D).

Non-invasive imaging of subclinical inflammation.



While early (local) inflammatory responses escape clinically (lack of pathological signs i.e. 1 day after s.c. LPS (25µg), A and B), subclinical inflammation (including the site of LPS injection, arrow) can be effectively registered by bioluminescent imaging (C), hence allowing to decipher even early-stage pathogenetic processes with highest sensitivities. Further this can be coupled with multiplex-imaging (i.e. by labeling of inflammatory cells etcetera with dyes of other spectra) to additionally visualize and dissect the dynamics of (subclinical) tissue responses.

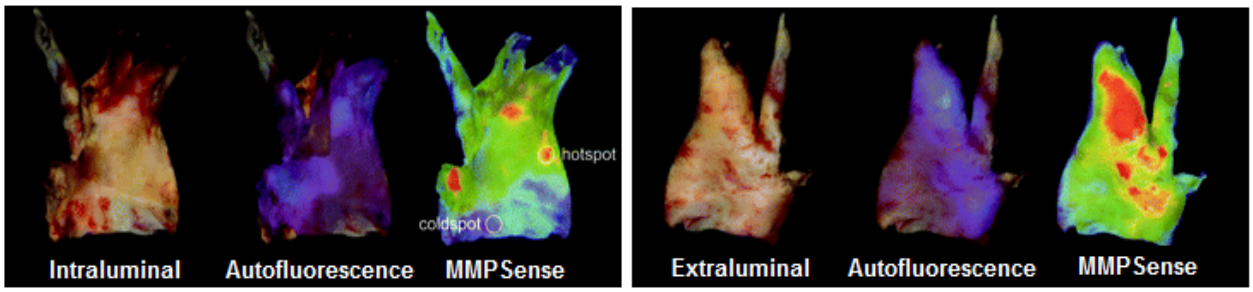
Dynamic visualization of mouse blood flow using fluorescent microspheres



Investigation of blood flow using fluorescent microspheres (MS) of different sizes. In situ images of mice 5 min and 1 day after i.v. injection of 2.5µm or 6.0µm MS. Blood flow (50nm MS) in the ventral aspect of hind limbs of intact objects (top) and after ligation of right femoral artery (bottom).

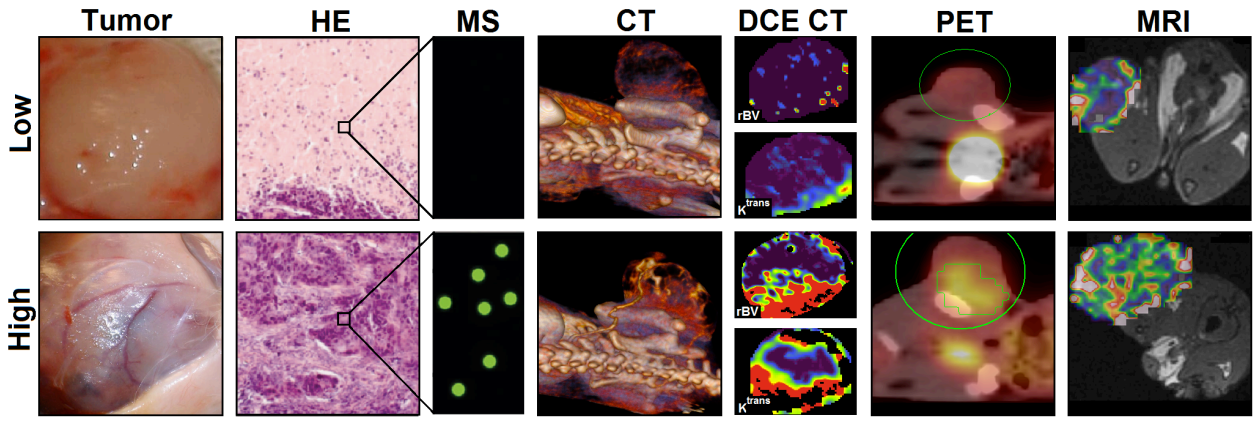
Mapping of MMP activity in clinical samples

(Wallis de Vries et al., Circulation, 2014).



Carotid endarterectomy specimen in white light (left), fluorescence before (Autofluorescence) and after incubation with near-infrared MMP-sensitive activatable fluorescent probe (MMPSense). Clear hot spots (red areas) were identified both at the intraluminal and extraluminal side, most present in the origin of the internal carotid artery and at the level of the common carotid bulb.

Optical imaging complements common clinical imaging technologies



Non-invasive in vivo optical imaging of tumor blood supply with fluorescent microspheres (MS) using IVIS Spectrum of tumors with different degree of vascularization (high / low) in a mouse model correlates well with common clinical imaging technologies such as computed tomography (CT), dynamic contrast enhanced CT (DCE CT: relative blood volume, rBV and tumor vessels permeability, K^{trans}), ^{18}F-FDG positron emission tomography (PET), magnetic resonance imaging (MRI) and histological examinations (HE).

Of note, apart from multispectral (multiplexing) and 3D imaging modalities, the use of optical imaging not only allows the non-invasive in vivo detection of bioluminescence or fluorescence. It also permits the use and detection of β(+) and β(-) emitting radiotracers commonly used for PET-Imaging or therapeutic applications (so called Cherenkov-Imaging). In addition, Cerenkov imaging of radiopharmaceuticals injected in small animals is a low-cost solution compared to PET and SPECT instrumentation. With this armamentum at hand, a broad spectrum of even clinically approved tracers and hence biological processes can be visualized in vivo (e.g. glucose uptake, bone metabolism, hormone, endocrine labelling etc.). Also it allows imaging β(-) emitting radionuclides that are being developed for therapeutic applications (i.e. in cancer) and that are not readily imaged by other existing methods.