Neuroimaging with neutrons and photons

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In this overview the concept of the complementary use of radiotracers produced with neutrons at the reactor of the Hahn-Meitner-Institut and photons produced at the synchrotron facilities BESSY and HASYLAB for 2D and 3D chemical imaging of metal- and metalloid-containing proteins in specific tissues - in particular in the central nervous system - is discussed. Metals and metalloids are known to be involved in various cerebral metabolic processes. The determination of their spatial distribution within the brain in health and disease may help to identify their specific sites of action and to elucidate their biological roles [1]. Possibilities and limits of the synchrotron techniques are shown in relation to the application of radiotracers used for specific labeling of those metal- and metalloid containing proteins, which are then detectable, by autoradiography.

Synchrotron radiation X-ray fluorescence analysis (SRXRF) allows the determination of the metal distribution in cryosections of tissues while synchrotron radiation-based Fourier transform infrared (SRFTIR) spectromicroscopy may provide information on the chemical composition of the sections of interest. These methods can therefore be used as valuable tools in studies on the role of metalloproteins in health and disease.

The development of superior 3D imaging methods was an advance for histological structural analyses. Tomography, specifically X-ray tomography, is a 3D imaging method with the advantage to be non-destructive. In all cases, the use of synchrotron radiation offers the high spatial resolution necessary for the investigation of brain tissue.

[1] M. Kühbacher et al., X-Ray Spectrometry 34 (2005) 2: 112-117.