Tumors located in distant locations may affect the nerve cells and cause neurologic changes by mechanisms other than direct invasion of brain tissue. Diseases caused by the remote effects of tumor cells are called paraneoplastic diseases. Tumors may affect brain cells from a distance by consuming too much food and energy that is crucial for neurons, by secreting endocrine substances altering nerve cell functions or – in the majority of the cases – by causing the immune system of the body to develop antibodies (autoantibodies) directed against nerve cells. In the latter mechanism, antibodies developed to kill tumor cells are suggested to accidentally (probably due to molecular similarities between tumor cells and normal nerve cells) bind neurons and destroy them. Most frequent paraneoplastic diseases are paraneoplastic encephalomyelitis, limbic encephalitis, progressive multifocal leucencephalopathy (PML), cerebellar ataxia, peripheral sensory neuropathy, subacute cerebellar degeneration and brainstem encephalitis.

Although the diagnosis is normally achieved by immunological methods, neuroimaging studies using MRI can be helpful in diagnostic process and may help in the determination of the primary tumor. Most important, effective treatment appears to require early identification. For these reasons, the ability to diagnose a paraneoplastic syndrome, follow its course, and treat it successfully are important. The most sensitive method to describe the CNS finding in paraneoplastic disease is Magnetic Resonance Imaging (MRI).

The lecture will focus on the most common CNS manifestations of paraneoplastic disease and will describe the main findings in MRI. The role of new morphological and functional MRI techniques will be discussed.

In paraneoplastic cerebral or cerebellar degeneration, atrophic changes may occur, usually after a year or more of symptoms. The absence of significant atrophy is, however, common. Diffuse or focal atrophy has been reported in paraneoplastic encephalomyelitis, but normal neuroimaging studies are the rule.

PML has typical MRI findings, however, PML is not a specific paraneoplastic syndrome and appears more often in immunocompromized patients. The classic PML appearance are areas of ill-defined hyperintensities within the subcortical white matter, sparing the basal ganglia in most of the patients. In progressive cases or in a later stage the lesions are confluent and can exceed down to the brain stem. Enhancement is normally absent. Therapeutic induced changes after chemo- and/or radiotherapy need to be differentiated. They normally involve the small vessels and present as arteritis or secundary ischemia. Resulting white matter changes are common: the appear at mass effects in the acute stage without enhancement and are normally reversible. The affect the white matter but spare the corpus callosum. In a later stage necrotic changes have been described.

In the past few years a number of advanced, non enhanced and contrast enhanced MR imaging techniques have been developed that provide new insights into the pathophysiology of brain diseases and which may have an impact on the diagnosis of paraneoplastic changes. These techniques include MR-spectroscopy, perfusion MR imaging, dynamic contrast enhanced MRI and diffusion tensor MR. There are only limited number of reports available so far, however most of these techniques have a great potential to allow a better insight in the underlying pathophysiological mechanisms. Diffusion imaging as a mixed morphological and functional tool to assess the integrety of the white matter in paraneoplastic disease and after
treatment. Mainly the fractional anisotropy (FA) is a powerful measure to study the integrity of the cerebral white matter in vivo. In a recent study using a fractional anisotropy index (FAI) from a whole brain 3T diffusion measurement, Deppe et al. (2007) presented a fully automated algorithms which represents a robust and observer-independent measure for the comparative assessment of white matter integrity, ideally suited for further statistical treatments.

Proton magnetic resonance spectroscopy or spectroscopic imaging (CSI) can add to the diagnostic accuracy of the MR imagings by ruling out brain tumos. Perfusion may help to better quantify the vascular component of the disease.