Module Number	Title:
5a	**Neuroimmunology**

Module type: compulsory elective	**Language:** English		**Group Size:** 12 students
Study semester: 2	**Availability:** summer semester		**Duration:** 1 semester
Workload: 420 hrs	**Credits:** 14 CP	**Contact time:** 123 hrs	**Independent Study:** 297 hrs

1 Courses

a) Lectures 4 PPW
b) Practical Course 5 PPW
c) Seminar 2 PPW

2 Intended Learning Outcomes

After completion of this module the students are able to describe the immune system and its relevance to physiological and pathological conditions of the nervous system.
The are able to define following terms: immune responses, blood brain barrier, antigen presentation, regulatory/effector immune cells, apoptosis, molecular mimicry, immunological diseases, autoimmunity, inflammatory conduction block.
They are capable to hypothesize on possible mechanisms involved in the development of neurological diseases and possible immunological therapy approaches.
They will be able to present a link between inflammation and degeneration and to summarize possible mechanisms of neuronal and glial damage in neuroinflammation and degeneration, comprising both primary and secondary neuroinflammatory diseases.

3 Content

Practical course

The module *Neuroimmunology* will cover the following topics:

1. Basics of immunology/regulation of the immune response
2. Chronic inflammatory disorders of the nervous system
3. Interactive exercises: animal models for autoimmune disorders of the central and the peripheral nervous system (CNS/PNS)
4. Interactions of immune cells and cells of the CNS and PNS: damage mechanisms and role of glia
5. Detection of inflammatory neurodegeneration *in situ* and *in vivo* (theory, preclinical animal experimental models + patient, imaging & optical coherence tomography & electrophysiology)

Students will perform the following methods during the practical course:
Immunology: Isolation and culture of immune cells from lymphatic organs and the nervous system. Investigation of immune cell function & phenotype (incl. multicolour flow cytometry, ^{3}[H] thymidine proliferation assays, cytokine ELISPOT & ELISA, migration assays). Induction of experimental disease in mouse and rat models of MS (experimental autoimmune encephalomyelitis/EAE), inflammatory neuropathies (experimental autoimmune neuropathy/EAN) and stroke (middle cerebral artery occlusion/MCAO). Investigation of immunological determinants in further neurological disorders such as brain ischemia
Neurobiology: Qualitative and quantitative histology and immunohistochemistry for major cell populations of the nervous system, including glia**.** Investigation of CNS neurogenesis *in vitro*, *in situ* and *ex vivo* considering the major neurogenic niches. Neurological (clinical) scoring of animals affected by chronic autoimmune disease. Electrophysiological examination of nervous system function. Detection of inflammatory neurodegeneration with PET and MR imaging as well as optical coherence tomography (OCT) *in vivo.* Living organotypic brain slices: preparation and comprehensive study by confocal microscopy, also using interaction models (co-culture of slices with immune cells).

4	**Teaching methods** Lectures with accompanying practicals with hands-on sessions and seminars
5	**Prerequisites** **Formal:** Successful completion of module 1. Proficiency in English level B2 of Common European Framework of Reference for Languages (CEFR) is requested. **With regard to content:**
6	**Examination types** Written exam
7	**Requirements for award of credit points** Participation in practical course and seminar, passing the final exam
8	**Module applicability (in other study courses)** Human medicine
9	**Assessment** The mark given will contribute to the final grade in proper relation to its credits.
10	**Module convenor and main lecturers** Prof. Dr. med. Orhan Aktas, Prof. Dr. med. Norbert Goebels, Dr. rer. nat. Carsten Berndt
11	**Further information** A FELASA certificate is recommended and can be obtained by attending Module 2c "Laboratory Animal Course" in advance. The regular attendance at the lectures is strongly recommended. The content of the lectures is prerequisite for the practical course and the seminar.