



# Analysis of changes in tumor-draining lymph nodes using forefront spatial and AI-driven image analysis

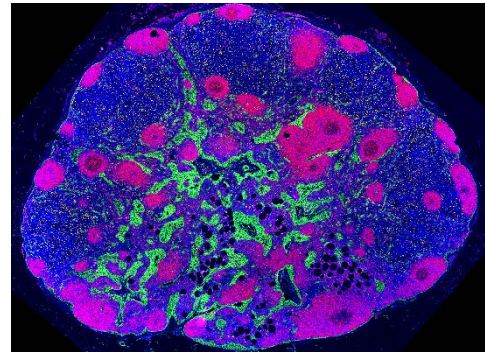
**Master student 30-45 points Autumn 2023**

**- Vascular immunology and cancer immunology**

The lymph nodes (LNs) play a central role in our adaptive immune system, the part of the immune system that can protect us against cancer. They also act as filters through which all tissue fluid drained by lymphatic vessels passes before it is emptied back into the bloodstream.

Dysregulation of the microenvironment of the LNs in cancer can increase the risk for spread of metastatic cancer cells in our body, but can also impair the body's ability to mount an immune response against the cancer. The

project you will contribute to aims to explore how aging and cancer inhibit the body's immune defense with focus on changes that occur in the tumor draining. It builds upon recent work from our lab, revealing dramatic cancer- and aging-induced vascular and stromal changes in tumor draining lymph nodes (TDLNs) from patients with cancer. In a new project we focus on pancreatic cancer which is one of the most difficult tumor forms, with very poor survival and where immunotherapy so far has had limited success, of reasons that are not fully understood. How the cancer changes the environment in the TDLNs may be one piece in the puzzle to understand this. You will learn how to stain tissue slides from the biobank with multicolor fluorescence, you will also learn pathology, how we can recognize changes by analyzing the tissue, and how to use AI (artificial intelligence) driven image analysis and image bioinformatical tools for analyzing the images.



You are very welcome to contact me to discuss and learn more!

**Email:** [maria.ulvmar@imbim.uu.se](mailto:maria.ulvmar@imbim.uu.se)

Maria Ulvmar, Senior Lecturer Experimental Immunology, Uppsala University, Sweden.

## References of relevance for the project:

Bekkhuis T, Martikainen T, Olofsson A, Franzén Boger M, Vasiliu Bacovia D, Wärnberg F, Ulvmar MH. Remodeling of the Lymph Node High Endothelial Venules Reflects Tumor Invasiveness in Breast Cancer and is Associated with Dysregulation of Perivascular Stromal Cells. *Cancers (Basel)*. 2021 Jan 8;13(2):211.

Bekkhuis T, Avenel C, Hanna S, Franzén Boger M, Klemm A, Bacovia DV, Wärnberg F, Wählby C, Ulvmar MH. Automated detection of vascular remodeling in tumor-draining lymph nodes by the deep-learning tool HEV-finder. *The Journal of Pathology*. 2022 Sep;258(1):4-11. doi: 10.1002/path.5981

Bekkhuis T, Olofsson A, Sun Y, Magnusson P, Ulvmar MH. Stromal transdifferentiation drives lipomatosis and induces extensive vascular remodeling in the aging human lymph node. *The Journal of Pathology*. 2023 Mar;259(3):236-25, doi: 10.1002/path.6030