Breast Tumor Microstructure Imaging with Diffusion MRI

Konstantinos Drymas Vrakidis

MSc Student, Medical Imaging, Utrecht University E-mail: <u>k.d.vrakidis@students.uu.nl</u>, Student no.: 3187909

Supervisor: Chantal Tax, Assistant Professor, UMC Utrecht

Layman's Summary

As cancer is described as the abnormal and excessive growth of cells within the human body. While cancer can appear within all types of organs, of particular research interest has been the cancer of the breasts due to its high prevalence, affecting over 2 million women worldwide every year. Multiple therapies have been developed to treat breast cancers, which involve surgical removal of the tumor along with cell-killing drugs and radiation exposure. The optimal treatment strategy is decided by doctors depending on very specific microscopic characteristics of the cancerous tissue. To determine these characteristics, medical tests are performed on the cancer patient. These tests, however, often include harmful side effects. In an attempt to address the need for a safer and more reliable testing method, Diffusion Magnetic Resonance Imaging (dMRI) can be considered a suitable candidate.

dMRI is a family of medical imaging methods that obtain anatomical images of the body contents based on the natural microscopic movement of water contained within tissues, without any harmful side effects. Currently, these methods have only been used along conventional medical tests, due to the low image quality that they provide and their inability to discern many characteristics of breast cancers. Novel dMRI methods, named microstructural dMRI, have been developed that generate anatomical images with higher quality and more sensitivity to microscopic details of the tissue. These methods have been mostly been tested in brain diseases. However, these methods show great promise as breast cancer tests, since their superior performance could potentially enable the distinction of characteristic features of cancers, allowing their use over the existing harmful testing procedures.

To examine the performance of these microstructural dMRI methods in breast cancer tests, a literature study was conducted. First, the reader is introduced to the characteristics of cancers that these methods aim to distinguish. Moreover, a brief description of the technical aspects of these methods is presented. Ultimately, scientific publications found to report on results using microstructural methods were compiled and compared. Despite the large number of microstructural dMRI methods that have been developed, admittedly only a very small collection of publications regarding breast cancer was found. To date, the evidence supports the expectations of the superior performance of microstructural dMRI over conventional dMRI ones. However, an insufficient amount of such evidence was found to suggest the replacement of existing medical tests with microstructural dMRI methods. Toward that goal, further research must be performed in clinical settings with patients.