

The first application of biological MR spectroscopy was to distinguish malignant from benign and from healthy tissues. The second was to monitor tumor development and progression. These studies commenced in the late 1970s initially on ill defined cell models. As cell biology and molecular genetics came of age the changes recorded by MRS started to make sense. Without realizing it MRS was the gold standard at the time, but was not recognized as there were no comparators. Pathologists who recognized the limitations of their discipline were keen to assist in unraveling the changes to cellular chemistry that were not morphologically manifest. Now with improved and more sophisticated MR technology to examine tumor development and progression, MR spectroscopy can rightfully start to take its place by providing new insights into the premalignant state and also cancer development and progression. We still rely on cell models to understand the relevance of the spectral changes to patient outcome. This combination will now allow a person's health to be managed on an individual basis.

For some invasive cancers, such as the breast, a biopsy is integral for understanding if the tumor has metastasized as MR spectroscopy remains the only technology that can identify chemical markers that are linked to nodal involvement by examining a primary tumor alone. These chemicals are present in too small a quantity to be recorded in vivo. This is the first of the MR spectroscopy applications that still cannot be achieved by any other technology.

For those women who carry the genetic mutations of the BRCA1 and BRCA2 genes, or those who come from a high risk family, the in vivo MR spectroscopy analysis of their radiologically healthy breast tissue can now identify multiple markers of premalignant changes. This will be the second of the MR spectroscopy capabilities that cannot be achieved by any other technology to date. It is also likely to be one of several applications that will catapult MR spectroscopy into main stream diagnostics.

Neurospectroscopy is generally underutilized by the neurosurgical community worldwide. The precise extent of the tumor extremities can be recorded in areas where contrast agent under reports. To achieve this end an interactive multidisciplinary team is needed for each patient. Unfortunately this is rarely seen and it will require the next generation of neurosurgeons to better understand the benefits of non invasive interrogation of neurochemistry preferably accompanied by fMRI.

When the malignant vs. benign status of an ovarian tumor can be determined preoperatively then the patient can be triaged to routine gynecological surgery or to a specialist gynecological oncological surgeon. Again a specialized team is required and the operator of the scanner needs to be in a position to decide on appropriate protocols to elucidate the status of the tumor real time.

The prostate has perhaps had the greatest effort expended over the years in an attempt to assist in improved management of the disease. However in the early days of the size of the voxel in vivo encompassed multiple zones in the prostate. MR spectroscopy on biopsy clearly shows the diagnostic molecules to differ in each zone thus rendering the technology less accurate than expected in vivo. With improved hardware the voxels are now reduced to fit well inside each zone and the introduction of 2D MR spectroscopy, the diagnostic capability in vivo should reach the accuracy of the biopsy which is at 99%. This will take time.

During 2013 one manufacturer has provided a spectroscopy platform that allows an MR technician (as opposed to a physicist) to collect robust spectroscopy data. Manufacturers are also now accepting of the fact that informatics analysis of such clinical spectroscopy data is needed to replace a trained spectroscopist at each site making the technology more available. For improved patient outcome a team available at the scanner to interpret the MR spectroscopy data real time will allow preoperative planning allowing a person's health to be managed on an individual basis. In those countries that are not struggling with a reduced healthcare budget this should now be possible.