Specialty area: Sunrise Session: Hot Topics in Body MRI

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Highlights:
- MRI has great potential for lymph node detection and characterization
- New MR-based techniques including hybrid PET-MRI, LN-MRI, and DMR are either in clinical use or being evaluated in humans that may improve detection of lymphatic metastasis

Talk Title: Assessment for lymph node metastases: New MR agents and techniques

Target Audience: Oncologists and radiologists with an interest in new MR techniques for cancer staging and metastasis evaluation.

Purpose: To review novel MR agents and techniques for assessment of lymph node metastatic disease.

Summary of Content:

The ability of MRI to provide both high-resolution macroscopic anatomic detail as well as microscopic information on tissue composition and metabolism provides great potential for improved detection of lymphatic metastasis and discrimination of benign from malignant lymph nodes. This talk will discuss some new and emerging MR agents and techniques for lymph node metastatic evaluation in patients.

1. PET-MRI hybrid imaging. The ability to combine the metabolic information of ^{18}F-FDG positron emission tomography (PET) with the anatomic detail and soft tissue contrast of MRI, as well as advanced MR techniques such as diffusion weighted imaging, MR spectroscopy, and dynamic contrast enhanced imaging, offers great potential for detecting metastatic disease and assessing treatment effect. Recent technological innovations have enabled the production of PET-MR scanners capable of producing high quality whole body hybrid images within the time range of standard clinical imaging studies. A recent study comparing same day PET-MR and PET-CT imaging in oncology patients (1) showed PET-MR to have superior accuracy for lymph node evaluation. Also, there were a higher number of discordant additional findings on PET-MRI compared with PET-CT that impacted clinical management, including sites of additional disease requiring treatment and incidental additional primary malignancies. Hybrid PET-MRI incorporating new PET tracers with increased tumor cell or molecule specificity may offer even greater diagnostic advantages over each individual modality alone.

2. Lymphotropic nanoparticle enhanced MRI (LN-MRI). LN-MRI is an investigational molecular imaging technique for lymph node characterization that utilizes lymphotropic nanoparticles (e.g. ferumoxtran-10 or ferumoxytol) as contrast agents. Lymphotropic nanoparticles are magnetic nanoparticles containing an iron oxide crystalline core and a dextran-based coating (2). When administered intravenously, these nanoparticles transit into the reticuloendothelial system, are taken up by macrophages, and subsequently localize to normal benign lymph nodes. The susceptibility effect of the iron oxide within the particles leads to signal loss on T2*-weighted MR images after nanoparticle contrast administration compared with pre-contrast imaging. Malignant lymph nodes, in which tumor cells have replaced normal lymphatic tissue, do not accumulate the nanoparticles

in the same manner and can be readily distinguished by LN-MRI. Clinical studies have shown LN-MRI to be significantly more accurate than conventional MRI for detection of nodal metastases in prostate cancer patients (3), and also to be a significant independent predictor of lymph node malignancy in genitourinary cancer patients when controlling for lymph node size (4).

3. Diagnostic magnetic resonance (DMR). DMR is an investigational micro-NMR platform for tumor biomarker detection using a miniaturized NMR microfluidic device for detection of molecule-specific magnetic nanoparticles in μL sample volumes based on R_2 changes. Rather than using MR for generation of diagnostic images, this technology utilizes the changes in magnetic properties induced by nanoparticle binding to quantify the level of molecular biomarkers expressed by cells of interest. The small sample volume and minimal background signal allows for accurate biomarker detection with minimal specimen processing, and has been shown to be effective for isolation and molecular characterization of tumor cells from fine needle aspirates, ascites, and peripheral blood of cancer patients (5-7). This technology offers the potential for serial minimally invasive determination of efficacy of molecule-directed (e.g. BRAF, HER2/neu, EGF) cancer therapies, as well as determination of cancer metastatic potential and aggressivity through circulating tumor cell quantitation, all on the microscopic level before changes in lesion size or number are detectable on conventional imaging. The superficial location of many lymph nodes would be ideally suited for serial DMR sampling.

Conclusion

The MR techniques discussed in this presentation have great potential for improving lymph node detection and characterization.

References

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