論　文　内　容　の　要　旨
Synopsis of Thesis

氏　　名 Name	松本　頌平
論文題名 Title	Ultra-High-Resolution T2-Weighted PROPELLER MRI of the Rectum With Deep Learning Reconstruction *Assessment of Image Quality and Diagnostic Performance* （Deep learning再構成を用いた直腸の超高分解能T2強調PROPELLER MRI : 画質と診断能の評価）

論文内容の要旨

〔目　的(Purpose)〕

To evaluate the impact of ultra-high-resolution acquisition and deep learning reconstruction (DLR) on the image quality and diagnostic performance of T2-weighted periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) imaging of the rectum.

〔方法ならびに成績(Methods/Results)〕

This prospective study included 34 patients who underwent MRI for initial staging or restaging of rectal tumors. The following 4 types of oblique axial PROPELLER images perpendicular to the tumor were obtained: a standard 3-mm slice thickness with conventional reconstruction (3-CR) and DLR (3-DLR), and 1.2-mm slice thickness with CR (1.2-CR) and DLR (1.2-DLR). Three radiologists independently evaluated the image quality and tumor extent by using a 5-point scoring system. Diagnostic accuracy was evaluated in 22 patients with rectal cancer who underwent surgery after MRI without additional neoadjuvant therapy (median interval between MRI and surgery, 22 days). The signal-to-noise ratio (SNR) and tissue contrast were measured on the 4 types of PROPELLER imaging.

1.2-DLR imaging showed the best sharpness, overall image quality, and rectal and lesion conspicuity for all readers ($P < 0.01$). Of the assigned scores for tumor extent, extramural venous invasion (EMVI) scores showed moderate agreement across the 4 types of PROPELLER sequences in all readers (intraclass correlation coefficient, 0.60-0.71). Compared with 3-CR imaging, the number of cases with MRI-detected extramural tumor spread was significantly increased with 1.2-DLR imaging (19.0 ± 2.9 vs 23.3 ± 0.9, $P = 0.03$), and the number of cases with MRI-detected EMVI was significantly increased with 1.2-CR, 3-DLR and 1.2-DLR imaging (8.0 ± 0.0 vs 9.7 ± 0.5, 11.0 ± 2.2, and 12.3 ± 1.7, respectively, $P = 0.02$). For the diagnosis of histopathologic extramural tumor spread, 3-CR and 1.2-CR had significantly higher specificity than 3-DLR and 1.2-DLR imaging (0.75, 0.78 vs 0.64, 0.58, respectively; $P = 0.02$), and only 1.2-CR had significantly higher accuracy than 3-CR imaging (0.83 vs 0.79, $P = 0.01$). The accuracy of MRI-detected EMVI with reference to pathological EMVI was significantly lower for 3-CR and 3-DLR compared with 1.2-CR (0.77 and 0.74 vs 0.85, respectively, $P < 0.01$), and was not significantly different between 1.2-CR and 1.2-DLR (0.85 vs 0.80). Using any pathological venous invasion as the reference standard, the accuracy of MRI-detected EMVI was significantly the highest with 1.2-DLR, followed by 1.2-CR, 3-CR and 3-DLR (0.71 vs 0.67 vs 0.59 vs 0.56, respectively, $P < 0.01$). The SNR was significantly the highest with 3-DLR imaging ($P < 0.05$). There were no significant differences in tumor-to-muscle contrast between the 4 types of PROPELLER imaging.

〔総　括(Conclusion)〕

Ultra-high-resolution PROPELLER T2-weighted imaging of the rectum combined with DLR improved image quality, increased the number of cases with MRI-detected extramural tumor spread and EMVI, but did not improve diagnostic accuracy with respect to pathology in rectal cancer, possibly because of false-positive MRI findings or false-negative pathologic findings.

論文審査の結果の要旨及び担当者

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論文審査の結果の要旨

MRIは組織コントラストが高く、直腸癌の局所評価に有用である。MRI-detected EMVIはpathological EMVIと同等の予後不良因子とされている。直腸の蛇行と蠕動により、部分容積効果とモーションアーチファクトが問題となる。T2強調画像の高分解能撮像、PROPELLERなどの動きに強いシーケンスの使用が解決策となり得る。Deep learning reconstruction（DLR）はMRI画像のノイズを減らし、画質を向上させる効果がある。本研究により直腸の超高解像度画像にDLRを組み合わせることで、画像の質が向上し、MRIで検出される壁外腫瘍進展やEMVIを確認できる症例数が増加した。これらのMRI所見は直腸癌の治療方針決定に大きな影響を与えるものであり、一定の臨床的意義があると考えられる。よって、この論文著者である申請者は学位に値するものと認める。