



Comparison of manual and semi-automated technique for ADC volumetric measurements in rectal cancer evaluation



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PURPOSE

- diffusion-imaging showed added value in diagnostic accuracy of conventional magnetic resonance imaging in diagnostics and response evaluation to neoadjuvant chemoradiotherapy in patients with locally advanced rectal cancer
- both qualitative and quantitative DWI is considered as a promising tool for rectal cancer response assessment

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PURPOSE

- measurements of tumor ADC values before and after neoadjuvant treatment and measurements of ADC value change induced by neoadjuvant therapy may have considerable diagnostic value in estimation of complete tumor response.

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PURPOSE

- it has been shown that prediction of complete tumor response to neoadjuvant chemoradiation therapy has the highest accuracy for whole tumor volume ADC measurements
- however, tumor volumetric measurements performed by manual per-slice tumor delineation can be highly time-consuming

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PURPOSE

- recently, several semi-automated segmentation techniques have appeared which can be used for different volumetric measurements in oncologic imaging

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PURPOSE

- the purpose of this study was to compare semi-automated volumetric ADC measurements of rectal cancer with manual ADC volumetric measurements in terms of measurement results and time required to perform measurements

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MATERIAL AND METHODS

- twenty-four patients with locally advanced rectal cancer were retrospectively included in the study
- all patients underwent baseline MR imaging prior to any treatment. MRI examinations were performed at 1.5 Tesla MR scanner using a phased-array body coil and spine array coil

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MATERIAL AND METHODS

- before MR imaging all patients were subjected to bowel cleansing
- a dose of 20 mg of the spasmolytic agent hyoscine butylbromide (Buscopan, Boehringer Ingelheim) was administered intravenously to all patients immediately prior to MR scanning to minimize bowel peristalsis and avoid motion artifacts

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MATERIAL AND METHODS

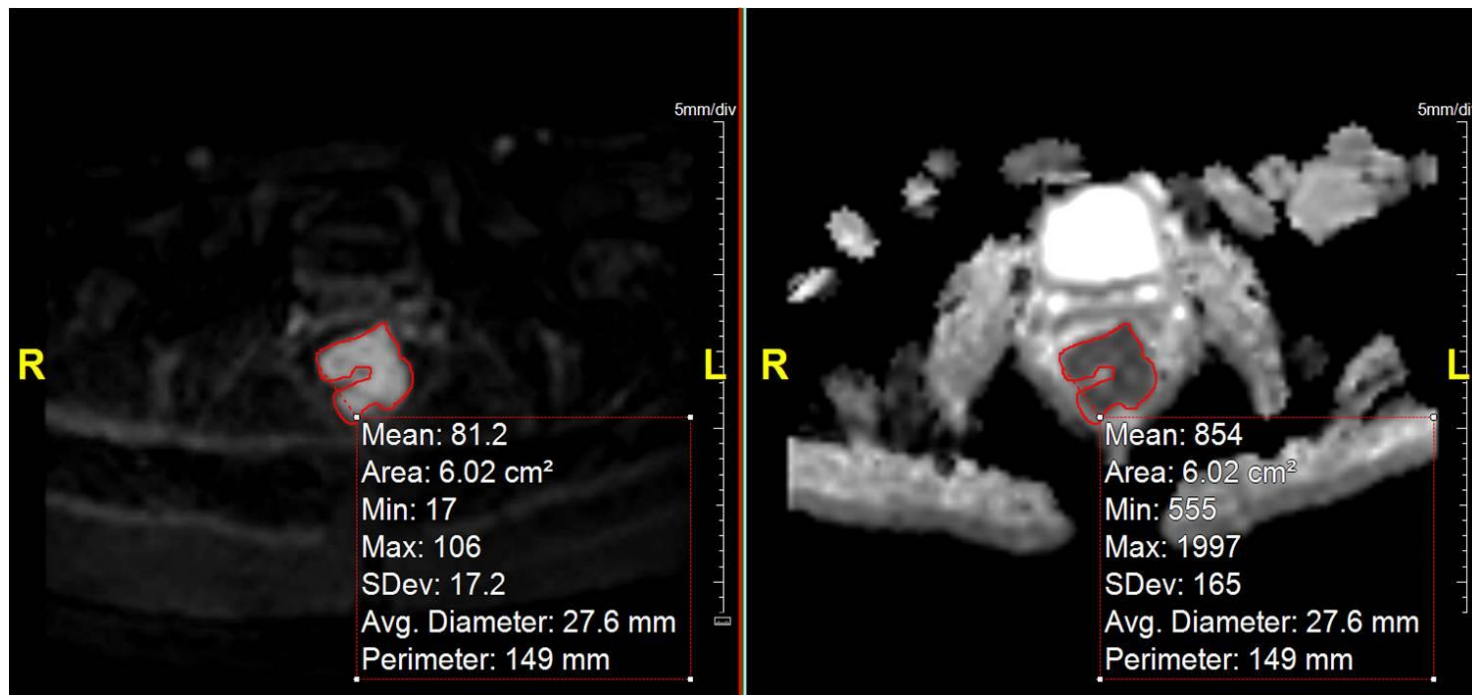
- the imaging protocol consisted of:
 - standard T2-weighted turbo spin-echo (TSE) sequences in three orthogonal directions and
 - an axial DWI (single-shot echo planar imaging) sequence with diffusion sensitivity values (i.e., b-values) of 50, 400 and 800 s/mm²
 - the DWI sequence was set and angulated identically to the previous axial T2w TSE sequence, perpendicular to the tumor axis

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MATERIAL AND METHODS

- rectal tumor volumetric ADC measurements were performed by manual and semi-automated techniques by one radiologist with 8 years of experience in rectal cancer MRI
- due to the higher resolution of DW images in comparison to ADC maps, ROIs were placed on DW images with high b values (800 sec/mm²) firstly. For manual technique ROIs were copied to the corresponding ADC maps; for semi-automated technique ROIs were automatically translated on the corresponding ADC maps [Picture 1]

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Picture 1. Semi-automated technique for ADC measurements in a rectal cancer patient: Due to the higher resolution of DW images in comparison to ADC maps, ROIs were placed on DW images with high *b* values (800 sec/mm²) firstly, and then were automatically translated on the corresponding ADC maps.

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MATERIAL AND METHODS

- the time needed to perform measurements was recorded for each technique
- volumetric ADC measurements and times from the two techniques were compared using intraclass correlation coefficient (ICC) and paired-samples t test

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RESULTS

- the mean tumor ADC values acquired with the different measurement techniques, manual and semi-automated, were $0.81 [\pm 0.07] \times 10^{-3} \text{ mm}^2/\text{sec} \pm \text{SD}$ and $0.89 [\pm 0.11] \times 10^{-3} \text{ mm}^2/\text{sec} \pm \text{SD}$, respectively
- ICC between two ADC measurement techniques was good (0.712)
- no significant differences between semi-automated and manual techniques were found in ADC measurements ($p=0.481$)

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RESULTS

- median measurement time required to perform volumetric ADC measurements by the manual technique was 82 seconds [range 54-105] and by the semi-automated technique was 228 seconds [range 177-311]
- time required to perform volumetric ADC measurements by the semiautomated technique was significantly shorter than the time required by manual technique ($p=0.033$)

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CONCLUSION

- volumetric ADC measurements have been shown to be useful in rectal cancer to assess response evaluation to neoadjuvant treatment
- however, incorporating volumetric measurements into daily workflow has not been practical and remains an important drawback
- semi-automated volumetric measurements are less time consuming than manual methods and may be a favorable option for clinical use

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CONCLUSION

- It has been shown recently that diffusion-weighted imaging volumetric measurements with a semi-automated segmentation, as a time-saving alternative to manual delineation of rectal cancer, is a promising tool, particularly for volumetric measurements of primary tumor, but must be further optimized for tumor response evaluation

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CONCLUSION

- we have found that semi-automated volumetric ADC measurements are equally accurate and less time-consuming than manual methods and may be a favorable option for clinical use
- finally, we think that volumetric measurements based on diffusion-weighted imaging and/or ADC quantification for tumor response evaluation should be of great interest for clinical practice

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