Value of automated retrospective correction of contrast-enhanced dynamic liver MRI – initial clinical experiences.

M. P. Lichy[1], C. Plathow[1], D. Plathow[2], W. Horger[3], B. Geiger[4], B. Kiefer[3], M. Horger[2], C. Chefdhotel[4], C. D. Claussen[1], and H-P. Schlemmer[1]

[1]University of Tuebingen, Tuebingen, BW, Germany, [2]University of Tuebingen, BW, Germany, [3]Siemens Medical, Erlangen, BY, Germany, [4]Siemens Corporate Research, Princeton, NJ, United States

INTRODUCTION

Multiphase three-dimensional contrast-enhanced dynamic liver scans (3D DCE MRI) are of high diagnostic relevance in the characterization of liver lesions, especially in the detection of primary liver malignancies, e.g. the hepato-cellular carcinoma (HCC) [1, 2]. But the precise and fast assessment of 3D DCE MRI data requires an exact anatomical match of the 3D DCE MRI data sets. However, breathing artifacts are a common observation. The purpose of our study was therefore to evaluate the clinical value of a retrospective anatomical correction of multi-breath hold 3D DCE MRI.

MATERIALS & METHODS

The implemented prototype allows the automated retrospective correction of multi-breath hold DCE-MRI data sets. It is also capable to synchronize the display of the native, arterial, portal-venous (p.v.) and late liver phase. These data sets can also be processed to obtain subtraction images.

So far, a total of 17 patients (mean age 66a, range 55 to 65a) with histological proven HCC were evaluated in retrospect. In 12 patients, a liver cirrhosis Child A / B was additionally reported. Additionally, 6 patients with focal nodular hyperplasia (FNH), 5 with an adenoma and 5 with liver metastases of a mamma carcinoma were evaluated. In all cases, at least one further MRI follow-up examination was available for further classification of suspicious lesions. All 3D DCE MRI were performed at 1.5 Tesla. For the acquisition of the dynamic data a T1w gradient-echo (FLASH3D-VIBE) sequence was used. Acquisition time was approximately 20 [sec], resulting resolution was (2.0x1.5x2.5) [mm^3]. Data evaluation was performed by two experienced radiologists for the original and corrected data sets (with and without subtraction). It included qualitative (presence of artifacts, degree of anatomical mismatch) and semi-qualitative (number of lesions per liver segment, lesions diameters) criterions. For quantitative data analysis, changes of signal intensities (SI) at the native, arterial, p.v. and late phase were evaluated by a region-of-interest (ROI) analysis. Therefore, ROIs were placed within the aorta, left / right hepatic arteries, tumor lesions, liver parenchyma and portal vein. The required total time for assessment of all livers lesions was documented, too.

RESULTS

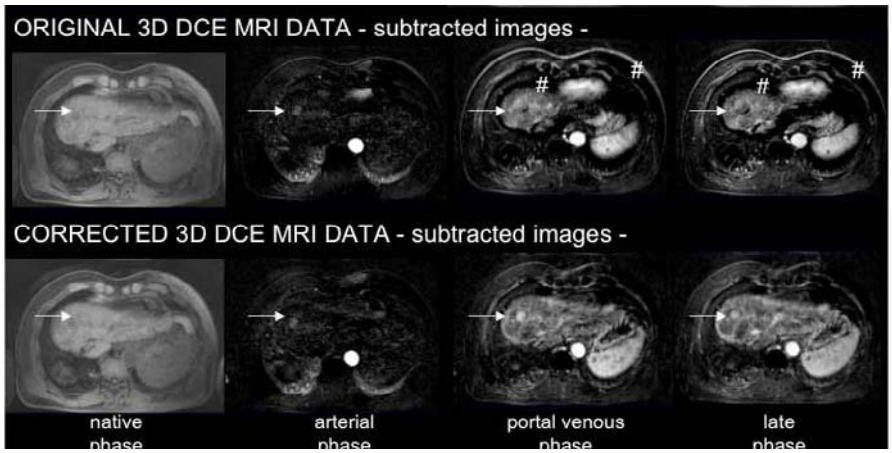
In all cases, the retrospective correction of 3D DCE MRI data sets was performed successfully. Quality rating was significantly higher for the corrected, subtracted images. SI changes of the left/right hepatic artery were found to be the most sensitive quantitative parameters to evaluate the function of the correction algorithm. However, a significant mismatch of 3D DCE MRI data sets was only obvious in tumor patients (HCC and metastases). No artificial lesions were introduced by the correction algorithm and no additional lesions were observed in the cases with FNH (lesions per patient: n = 1.3), adenoma (n = 1.4) and metastases (n = 1.8). While not statistically different, however, in patients with a HCC numbers of detected lesions differed (original data sets: n = 4.4; corrected and subtracted DCE MRI data: n = 4.7). The total reporting time was significantly reduced by the synchronous display of the corrected DCE MRI data sets in all cases. This was most obvious in patients with HCC: 597 sec (mean) for the report with the original data sets and the conventional clinically used image viewer; 231 sec (mean) for the corrected and subtracted examinations.

CONCLUSION

The presented software offers the automated anatomical correction of multi-breath hold 3D DCE liver MR examinations and the subtraction of multi-phasic data sets within clinical routine. It enables an improved display and assessment of pathologic findings.

FIGURE

Example of a patient with a small HCC (lesion marked by arrows). Caused by a mismatch of the arterial and p.v. as well as late phase, subtraction artifacts are clearly visible (marked by #) in the original data sets and subtracted images are of no diagnostic value. In the case of the subtraction of the corrected images, these artifacts are not present and the lesion is well defined.



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