AN INTERACTIVE COMPUTER-AIDED DIAGNOSIS SYSTEM FOR DETECTING METASTATIC LYMPH NODE IN FEMALE PELVIS BASED ON DIFFUSION WEIGHTED IMAGING

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Purpose: Diffusion weighted imaging (DWI) has shown to be a promising tool to highlight lymph nodes[1]. However, manual depiction of lymph nodes on DWI is a time-consuming process. In addition, a large variation in inter- and intra-observer reproducibility exists in both detecting lymph nodes in DWI and measuring their size and apparent diffusion coefficient (ADC) values[2-3]. In this context, we developed an interactive system of computer-aided detection and diagnosis (CAD) for lymph node labeling on DWI, with the aim to accelerate the detection and assessment processes and as well as to generate reproducible segmentation results based on objective imaging characteristics.

Methods: The pelvic DWIs from 10 female patients, aged between 42 and 60 years, with pathological confirmed gynecological cancer were used as test dataset. The DWIs were acquired between August and December, 2006. All scans were performed on a 3-T magnetic resonance scanner (Tim Trio; Siemens, Erlangen, Germany). DWI was obtained in the axial plane using a single-shot spin-echo echo-planar with chemical-shift-selective fat-suppression technique (repetition time of 3300 ms, echo time of 79 ms, average number of signals: 4; section thickness: 4 mm; gap 1 mm; matrix: 128×128; field of view: 20×20 cm^2. The b-value was chosen to be 0 and 1000 s/mm^2. First, a Gaussian filter was applied for noise reduction. Hessian determinant of each pixel of the filtered image was then calculated and a threshold was applied to the Hessian determinant maps to identify blob-like structure as lymph node candidate. After the lymph node candidate detection, segmentation was performed using Chan-Vesse active contour model, which locates object's boundary based on edge energy. An exclusion criterion was applied based on the size of segmented object to reduce false positive rate. Subsequently, the location, size, long and short axis as well as mean and minimum ADC values of each individual detected lymph node were analyzed automatically. All codes were written in MATLAB version 7.4 R2007a (MathWorks,Natick, MA, USA).

Results: The execution time for processing DWI of a single patient was within seconds. Using radiologists' final interpretation based on review of the CAD result as the gold standard, the performance of the CAD was evaluated. With optimal empirical parameters, the CAD showed a sensitivity of 85.0% with a positive predictive rate of 76.9%. Total 247 lymph nodes in 10 patients were evaluated. Figure 1 demonstrates the representative images from original DWI and corresponding automatically processed image, where lymph nodes were labeled in red.

Conclusions: The CAD proposed here is a robust, sensitive and reliable method for detection and assessment of lymph node on DWI. These features render it a prospective tool for differentiating malignant and benign lymph node on DWI.

Reference:

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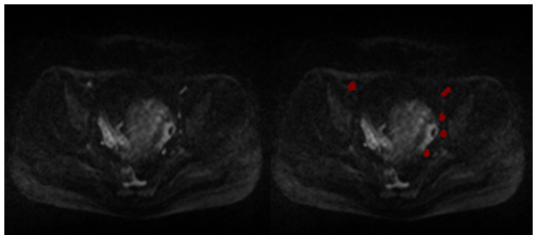

Figure 1. The original DWI (left) and the corresponding automatically processed image by CAD (right), where lymph nodes were labeled in red.