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ORIGINAL ARTICLE

Prediction of the consistency of pituitary adenoma: A comparative study on diffusion-weighted imaging and pathological results

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Pituitary Adenomas;
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Summary
Objectives: This study aims to evaluate the role of BLADE magnetic resonance (MR) diffusion-weighted imaging (DWI) and other traditional MRI parameters to predict pituitary adenoma consistency in combination with pathological results.
Methods: Thirty-four patients with surgery and pathological diagnosis of pituitary adenomas were included in this study. All exams were performed at 3.0 T with traditional MRI sequences and BLADE DWI to acquire MRI parameters, then the consistency and collagen content of pituitary adenomas were evaluated at and after surgery respectively to explore the capacity of MRI technique to predict consistency or its correlation with collagen content.
Results: According to consistency evaluated at surgery, 29 pituitary adenomas were categorised as soft while others were regarded as hard. SI ratio of pre- or post-enhanced T1-weighted images, T2-weighted images or ADC values exhibited no significant relationship with adenoma consistency. To some extent, the ADC ratio had diagnostic value to predict hard consistency for ADC < 1.077, while the AUC was 0.7724 for the ROC curve. H.E. staining and Masson staining were used to assess collagen content qualitatively and quantitatively. Adenoma consistency was relevant to collagen content while the cut-off value for collagen content between soft and hard tumours was 15.39%; the ADC ratio exhibited close relationship with collagen content, showing a lower ADC ratio for increasing collagen content.

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Conclusions: This study revealed that the ADC ratio decreased with increasing collagen content and predicted hard consistency of tumours for ADC < 1.077. Correlation between ADC ratio and tumour consistency needs further exploration.

Introduction

As the most common lesions in the sellar region, pituitary adenomas rank third among all brain tumours with an incidence of 73∼94 cases/100,000 inhabitants [1,2]. Because of their possible hormonal secretion and mass effect, pituitary adenomas are always treated by surgery after non-effective drug therapy [3—5]. There are two kinds of surgery to remove those pituitary adenomas, named trans-sphenoidal endoscopic surgery and craniotomy, but which surgery to choose partly depends on an inner feature of the tumours — its consistency [6,7]. Trans-sphenoidal endoscopic surgery is more suitable for the tumours with soft consistency which are easy to pull out, while craniotomy is suitable for harder ones [6,7]. So, preoperative evaluation of tumour consistency can help to determine the best operation methods and treatments, which will not only increase the possibility of complete tumour removal, but also reduce recurrence rates.

Because of its high resolution, MRI has shown great advantage in brain imaging and emerges to be the best way for consistency evaluation. Previous studies have attempted to predict pituitary adenoma consistency by using conventional and some novel MRI sequences, but the results are controversial, especially for diffusion-weighted imaging (DWI) [8]. DWI is used to measure aberrancies in the expected Brownian motion of free water [9,10]. In recent years, DWI has shown utility in predicting the consistency of pituitary adenomas that has been verified in several studies [8,11,12]. However, because of the B0-related artefacts in the sellar region, their results were not so convincing [13—15]. BLADE DWI is a turbo spin echo-based diffusion-weighted imaging technique that can oversample the region in the centre of the k-space to correct for heterogeneities prior to combining the data. Depending on the merit of turbo spin-echo (TSE) techniques, B0-related artefacts from sinuses and eddy currents can theoretically be dramatically reduced [16]. Therefore, BLADE DWI can enable the visualization of the boundary between the sellar lesion and peripheral structures, which is more suitable for preoperative evaluation of tumours in the skull base [17].

In clinical practice, we have noticed that pituitary adenomas with soft consistency seem to have higher T2 signal intensity (SI) and ADC value but lower enhancement, findings which were not aligned with or totally opposite to previous research results [8,11,12,18,19]. So this study was designed to evaluate the diagnostic value of MRI parameters, especially ADC values, in the pre-evaluation of the consistency of pituitary adenomas.

Materials and methods

Patient population

This study was designed as an observational, perspective investigation between June 2013 and February 2014. Our institutional review board approved the research protocol in this study, and written informed consent for the MR study was obtained from every patient before participation. Patient recruitment and imaging were carried out between June 2013 and February 2014. All patients were suspected to have pituitary adenomas with clinical manifestations or laboratory abnormality and underwent MRI before surgery in our hospital. Subjects who had received previous pituitary surgery and whose MRI strongly indicated haemorrhage or cyst in pituitary adenomas were excluded because of their obviously soft contents. Subjects whose pathological diagnosis was not pituitary adenoma were also excluded from our study.

Imaging technique

All MR images were acquired on a Siemens Verio 3.0 T system equipped with an 8-channel head coil. MR imaging of the sellar region was performed using the following routine sequences: sagittal and coronal pre-contrast T1-weighted images (TR/TE 2000/18 ms, matrix 358 × 512, one excitation, FOV 18 cm, bandwidth 122 Hz/pixel, slice thickness 3 mm without intersection gap); coronal T2-weighted images (TR/TE 4000/94 ms, matrix 314 × 512, two excitations, FOV 24 cm, bandwidth 122 Hz/pixel, slice thickness 3 mm without intersection gap); coronal pre-contrast BLADE DWI images (TR/TE 3210/125 ms, matrix 256 × 256, one excitation, FOV 25.6 cm, bandwidth 260 Hz/pixel, slice thickness 3 mm without intersection gap).

Contrast-enhanced T1-weighted images were then obtained in the sagittal and coronal plane using the same parameters as those for the pre-contrast images. All coronal DWI scans were performed on the same slices to make consistent comparisons. Contrast-enhanced T1-weighted images were obtained during bolus injection of Gd-DTPA 20 mL. The dose of gadolinium contrast material was 0.1 mmol/kg (0.2 mL/kg).

Region of interest (ROI) for SI and ADC values were drawn directly on images obtained from T1, T2, ADC maps and enhanced T1 images respectively. ROIs were anatomically identified in the central and solid-appearing portions of the pituitary adenomas. ROIs were also placed in normal grey matter in T1WI, enhanced T1WI images, normal white matter in T2WI images and normal brainstem in ADC maps. Two