Proton decoupled ^{31}P MRS of head and neck tumors in vivo at 1.5T and 3T

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Introduction

Prediction of treatment response using ^{31}P MR spectroscopy at 1.5T has been reported for head and neck squamous cell carcinoma (HNSCC) (1) and non-Hodgkin's lymphoma (2). However, these studies were limited to patients with large superficial nodes due to the low sensitivity of ^{31}P MRS. The availability of higher field magnets such as 3T scanners, lends the possibility of increased sensitivity and hence the potential of reducing the voxel sizes for 31P MRS studies. We performed a preliminary study on patients with head and neck cancer at 3T to test this hypothesis.

Materials and Methods

^{31}P MRS data were acquired from eleven patients who had palpable metastatic cervical lymph node masses and did not have any prior treatment history. For each patient, the most solid and largest metastatic node was identified by a neuroradiologist based on the fat saturated T_2 weighted images. Three dimensional ^{31}P chemical shift imaging was performed with proton decoupling and nuclear overhauser enhancement using a custom-built 7-cm ^{1}H/^{31}P dual tuned surface coil. Six patients were scanned at 1.5T and five patients at 3T. The mimumum voxel size for 1.5T magnet was 15.6 cm^3, while a voxel size of 8 cm^3 was used for studies at 3T. All other sequence parameters were kept same for the two magnets including TR (1s), number of averages (13), flip angle and pulse power for the NOE and decoupling pulses. The integrated intensities of metabolite peaks were computed using a Siemens Leonardo workstation. The patients have been categorized as complete responders (CR, with no evidence of disease), or partial responders (PR, with evidence of residual disease) based on clinical or pathological (if surgery was performed) assessment at the end of chemo-radiotherapy. The difference between the groups was tested using t- test with 95% significance level. The institutional review board approved this study, and written informed consent was obtained from all subjects before the scans.

Results and Discussion

Proton decoupled multi-voxel ^{31}P MRS studies were successfully performed on both the 1.5T and 3T magnets. Figure 1a shows a representative ^{31}P spectrum from a patient at 1.5T. A substantial increase in signal to noise was noted from the studies at 3T (Figure 1c) even when the voxel was approximately 50% smaller (8 cm^3 versus 15.6 cm^3) indicating the benefit of performing these studies at 3T. Fig.1b shows PME/βNTP and PDE/βNTP ratios from patients exhibiting CR and PR. Though the sample size is small, this data demonstrates higher pre-treament PME/βNTP and PDE/βNTP ratio in PR. These results are in agreement with our previous reports that higher PME/□NTP levels predict for poor response to the treatment (1). A similar analysis was not possible for patients studied at 3T since these patients are still undergoing treatment and their response status is not known. In conclusion, this preliminary study demonstrates increased sensitivity of ^{31}P MRS studies at 3T, which might facilitate such studies in smaller tumors.

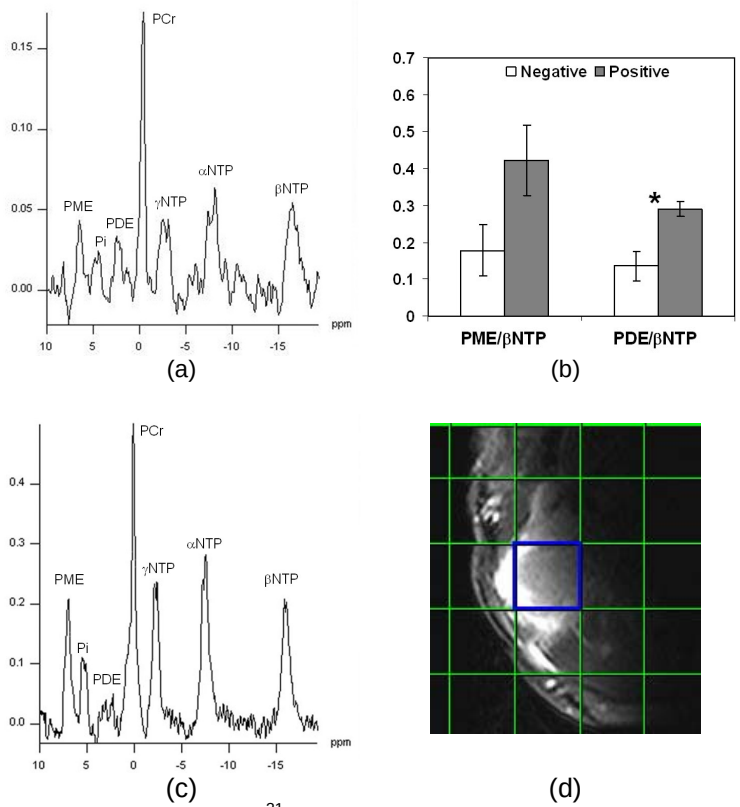

Figure 1. Representative ^{31}P spectrum of HNSCC at 1.5T (a) and 3T (c). (b) Pretreatment PME/βNTP and PDE/βNTP levels for patients scanned at 1.5T that exhibited positive (n=2, gray bar) or negative (n=3, white bar) pathology from the dissected nodes after neck surgery. * Significant difference ($p<0.05$, t-test). The spectrum in (c) was acquired from the voxel shown in (d).

Reference

1. Shukla-Dave A et al. Acad Radiol 2002;9:688-694
2. Arias-Mendoza F et al., Acad Radiol 2004;11:368-376

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