Differentiating Squamous Cell Carcinoma from Other Types of Tumors in the Head and Neck Region by ^{1}H MRS

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Introduction

Ninety-five percent of head and neck cancers are likely to be squamous cell carcinoma (SCC). The remaining 5% could be anything ranging from adenocarcinoma to lymphoma. It is sometimes difficult to know the exact type upon initial clinical presentation and subsequent standard pathology. However, it is essential to know if a given particular tumor is a non-SCC since that will require special staining techniques for reliable identification, and for appropriate treatment and management strategy. We have previously used proton magnetic resonance spectroscopy (MRS) to characterize the spectral features of SCC. The objective of this study was to assess the value of ^{1}H MRS in identifying the non-squamous cell types of head and neck cancer.

Patients and Methods

Ninety-six head and neck tumor specimens were obtained at the time of biopsy and kept frozen at -70 ^{0}C. The specimens were mounted in small capillary tubes, and subjected to ^{1}H MRS (360 MHz) at 25 ^{0}C with presaturation of the water signal. Acquisition parameters included: 90^0 pulse of 8 µs, number of scans = 256 or 640 depending on the size of the tissue, spectral width = 5000 Hz, recycle delay = 2.41s, and time domain data points = 4K. Immediately following the MRS experiments, all samples were fixed in formalin for histopathological assessment. The spectra were subjected to the statistical classification strategy – a pattern recognition-based method, which finds common features among the spectra (1).

Results and Discussion

Spectra of SCC generally show elevated choline, and depressed creatine levels (2-4). Other resonances commonly seen in the spectra of SCC include taurine, glutamic acid, glutamine, lysine, lactic acid and lipid. The spectra of eighty-nine of the samples (i.e., 92.7%) were found to conform to the SCC profile. The spectral profiles of the remaining 7 cases were uncharacteristic of SCC. Subsequent standard biopsies also confirmed the findings. Since these 7 cases were also of different types, they did not have one common spectral profile among them. These cases included: adenocarcinoma (two), lymphoma, adenoma, angiosarcoma, neuroblastoma, and muco-epidermoid. Some examples of these are shown in Fig. 1. As can be seen in the figure, the spectra of the non-SCS tumors have more contribution from the lipid signal compared to those of SCC tumors. Moreover, the choline resonance which was quite prominent in the spectra of SCC tumors wasn't so in the non-SCC tumors.

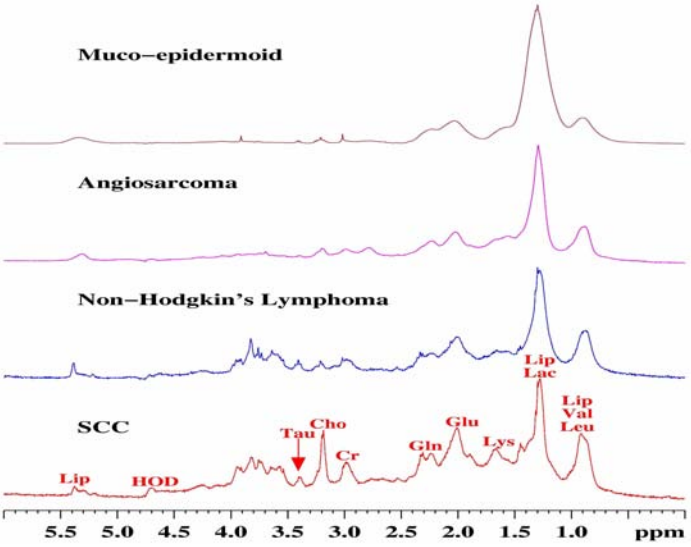

Figure 1. ^{1}H MR spectra (360 MHz, 25 °C) of various head and neck tumors.

Conclusion

The MRS technique which requires a very small tissue sample for analysis can potentially be used as a rapid screening system to identify the approximately 5% of non-squamous cell cancers that require special attention.

References

1. Lean CL, et al., *Annu. Rep. NMR Spectrosc.* **48**: 71 (2002).
2. Mukherji SK, et al., *AJNR Am J Neuroradiol* **18**:1057 (1997).
3. El-Sayed S, et al., *Head Neck* **24**:766 (2002).
4. Bezabeh T, et al., *AJNR Am J Neuroradiol.* **26:** 2108 (2005).