

# Detection of cytoplasmic lipid within neuroendocrine tumors of the pancreas on chemical shift MRI

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## PURPOSE

Chemical shift MRI has been clinically applied in the field of body imaging to detect small amounts of lipid based on the inherent difference in the resonant frequencies of water and fat protons <sup>(1)</sup>. Radiologic detection of lipid components within pancreatic lesions has been evaluated for a variety of pancreatic lesions, and this information has been reported to enable radiologists to differentiate the lipid-containing pancreatic lesions from pancreatic neuroendocrine tumors (NETs) <sup>(2-5)</sup>. However, there have been no reports regarding the utility of chemical shift MRI for detection of intracytoplasmic lipids within pancreatic NETs. Therefore, the purpose of this study was to determine whether cytoplasmic lipids in pancreatic NETs can be identified on chemical shift MRI and clarify CT and MRI characteristics of lipid-containing pancreatic NETs.

## METHODS

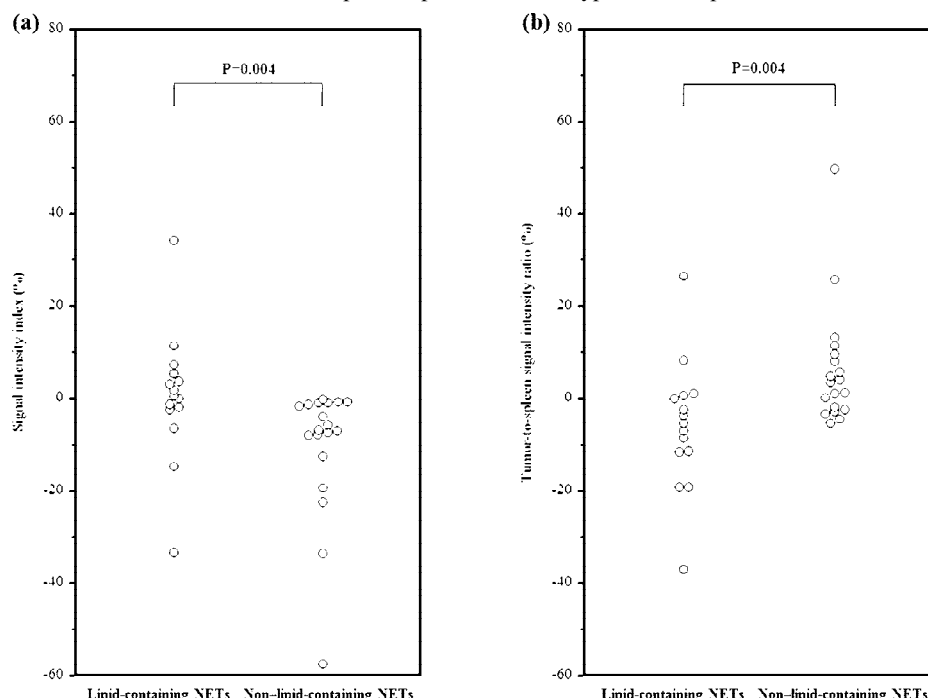
Chemical shift MRI performed before pancreatectomy in 29 patients with 34 pancreatic NETs were reviewed. MR images were obtained with 1.5-T (n = 15) or 3.0-T system (n = 14). Chemical shift MRI was performed with a breath-hold 2D sequence with the 1.5-T (n = 15) and one of the 3.0-T MR systems (n = 4), and with a 3D dual gradient-echo sequence with the other 3.0-T MR system (n = 10). We used the shortest possible echo time (TE) for the out-of-phase images with longer TE for the in-phase image on both 1.5 and 3.0-T MR systems. Degree of tumor attenuation on enhanced CT, and signal intensities on conventional (T1- and T2-weighted) and subtraction chemical shift MR images were qualitatively analyzed and compared alongside adipose differentiation-related protein (ADRP) immunohistochemical staining (ADRP-positive=lipid-containing; ADRP-negative=non-lipid-containing) results, which is a specific marker for diseases characterized by lipid accumulation. Signal intensity index and tumor-to-spleen signal intensity ratio were quantitatively assessed. Findings were analyzed by Fisher's exact test or the Mann-Whitney U test.

## RESULTS

There were 15 pancreatic NETs (44.1%) that contained ADRP-positive lipid-containing cells in 12 patients (41.4%). Degree of tumor attenuation during each phase was not significantly different between lipid-containing and non-lipid-containing pancreatic NETs (unenhanced CT,  $P = 0.128$ ; early phase,  $P = 0.888$ ; portal venous phase,  $P = 0.443$ ; delayed phase,  $P = 0.359$ ). No significant difference between lipid-containing and non-lipid-containing NETs was observed in terms of signal intensity on in-phase ( $P = 0.698$ ), out-of-phase ( $P = 0.057$ ), or fat-suppressed T2-weighted MR images ( $P = 0.798$ ). Four of the 15 lipid-containing NETs exhibited high signal intensity on subtraction chemical shift imaging, consistent with lipid content, and the association of high signal intensity on subtraction chemical shift imaging with lipid-containing NETs was significant (4 of 15 lipid-containing NETs, 26.73%, vs. 0 of 19 non-lipid-containing NETs, 0%,  $P = 0.029$ ). Signal intensity index of lipid-containing NETs was significantly higher than that of the non-lipid-containing NETs ( $0.6 \pm 14.1\%$  vs.  $-10.4 \pm 14.4\%$ ,  $P = 0.004$ ) (Fig. 1a). Eight of 15 lipid-containing NETs had positive of signal intensity index values. Tumor-to-spleen signal intensity ratio was significantly lower in lipid-containing than in non-lipid-containing NETs ( $-5.9 \pm 14.1\%$  vs.  $6.3 \pm 13.0$ ,  $P = 0.004$ ) (Fig. 1b).

## CONCLUSION

Enhanced CT and conventional MRI findings are similar in lipid-containing and non-lipid-containing NETs. Chemical shift MR imaging can demonstrate cytoplasmic lipids in lipid-containing pancreatic NETs. Pancreatic NETs should be included in the differential diagnosis whenever chemical shift MRI demonstrates lipid components within hypervascular pancreatic tumors.



**Figure 1: Scatterplot showing the differences in signal intensity index (a) and tumor-to-spleen ratio (b) between lipid-containing and non-lipid-containing pancreatic neuroendocrine tumors (NETs).**

(a) Signal intensity index is significantly higher in lipid-containing than in non-lipid-containing NETs ( $P = 0.004$ ). (b) There is a significant difference in tumor-to-spleen signal intensity ratio of lipid-containing and non-lipid-containing NETs ( $P = 0.004$ ).

## REFERENCES

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